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'*Knowledge is proud that he has learned so much,*
Wisdom is humble that he knows no more.'—COWPER.

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Animal Physiology.

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THE EAR.

THE anatomy and physiology of the ear is not nearly so thoroughly understood as that of the eye; it will, therefore, not be necessary to enter into such great detail in its description. For anatomical purposes the ear may be divided into three parts: an external, middle, and internal ear.

Anatomy of Ear.

The *external ear* consists of the external appendage and the canal connected with it. The part projecting from the head is called the *pinna*, and consists largely of yellow elastic cartilage. The canal leading from this is called the *external auditory canal.* It is about 1¼ inch long, and reaches to the drum of the ear, running from without inward and slightly forward. The outer part of the canal is lined with cartilage and fibrous tissue, the inner part is bony; a thin skin continuous with that of the outer integument covers the canal, and is reflected over the outer surface of the drum.

Fig. 79.

Diagrammatic view of the left ear, showing *aaa*, the external ear; 1, the external auditory canal; 2, membrana tympani; 3, malleus; 4, incus; 5, stapes; *e*, cochlea; *f*, semicircular canals.

The *middle ear* includes the cavity of the drum or tympanum, and its boundaries (Fig. 79). It contains the small bones or ossicles of the ear, and certain minute muscles and nerves. The *membrana tympani*, or drum membrane, separates it from the external auditory canal. This membrane is concave outwards and obliquely placed, so as usually to incline at an angle of 45° to the perpendicular. The three ossicles of the ear are contained in the upper part of the tympanic cavity. The handle of the *malleus* (3, fig. 79) is fixed to the tympanic membrane, while its head articulates with the *incus* (4, fig. 79), which in its turn is connected with the *stapes* or stirrup-bone. The wider end of the stapes is fixed to the membrane covering the fenestra ovalis (which connects the middle and internal ear). Three minute muscles are connected with these ossicles, and by their contraction help to relax or render tense the membrana tympani.

Fig. 80.

Diagrammatic view of the ear, showing method of transmission of waves of sound. A. External Canal. B. Membrana tympani. C. Chain of ossicles. D. Membrane covering fenestra ovalis. E. Vestibule. F. Semicircular canals. G. H. Cochlea. J. Eustachian tube.

The *Eustachian tube* (J. Fig. 80) passes from the tympanic cavity forward, inward and slightly downward. It is about 1½ inch long, and opens below into the cavity of the pharynx just behind the soft palate. Its lowest end can be pulled on and thus opened by certain muscles of the palate, and by this means an aerial communication between the middle ear and the throat is kept up, and any inequality of atmospheric pressure on the two sides of the tympanic membrane is prevented. The entire cavity of the tympanum is lined by a thin mucous membrane, continuous with that of the throat.

Physiology of middle Ear.

The functions of the different parts of the middle ear in relation to hearing may be considered before describing the anatomy of the internal ear.

The tympanic membrane is thin and translucent, and has attached to its inner surface a chain of ossicles which transmit vibrations of sound onward to the internal ear. When the membrane is perforated or destroyed the acuteness of hearing is more or less affected. This is explained by the well known fact that sonorous vibrations transmitted through the atmosphere to solid bodies like the bones of the ear, lose considerably in intensity; but when they are received by a delicate membrane, under the conditions of the membrani tympani, they are transmitted with but little loss of intensity. The membrane is fixed at its circumference, and has air on both sides of it, so it is under the most favourable conditions for vibration. It is subject to variations in tension, as may be proved by shutting the mouth and nose, and then attempting a full inspiration. Air is thus drawn from the tympanic cavity, and the external air renders the membrane more than usually concave. In this condition grave notes are unheard, but high-pitched notes seem more intense. The act of swallowing relieves the condition, because during swallowing the pharyngeal end of the Eustachian tube is opened, and thus air enters the tympanic cavity and restores the normal balance of pressure on the two sides of the tympanic membrane.

The arrangement of the bones connected with the membrane is such that the direction of the sonorous vibrations is not interfered with. The vibrations are transmitted from the membrane (a a, fig. 79) in the direction indicated by the arrows to the long process of the malleus. They are propagated from the process of the malleus to its head (b); thence into the incus (c), the long process of which is parallel with that of the malleus; and from the incus they are transmitted to the stapes, which is united at right angles to the incus. The ossicles act as a single solid body in conducting vibrations to the labyrinth, and there is but little loss of intensity in the transit.

The membrane has this peculiarity, that it has no fundamental note of its own, and consequently there is no undue prominence of any one note in the sounds we hear. Destruction of the membranes of both ears does not necessarily produce total deafness, as the waves of sound may still be conducted along the ossicles to the auditory nerve. Even when partial or entire destruction of the ossicles occurs, there may be slight retention of hearing power, as sound vibrations can be transmitted by the bones of the head. Under such circumstances the tick of a watch placed close to the external ear would be inaudible, but might be heard when placed on the head.

The Internal Ear.

The *internal ear* is also called the labyrinth; it is divided into three parts, the vestibule, semicircular canals, and the cochlea. These are contained in the petrous part of the temporal bone, and their general arrangement is shown in fig. 79. The vestibule communicates with the tympanic cavity or middle ear, by means of the fenestra ovalis, which is closed in the natural state by the base of the stapes. In the posterior wall of the vestibule are five small openings leading to the semicircular canals, and a larger opening below leading to the cochlea. The general arrangement of the semicircular canals is shown in figs. 79 and 80.

The cochlea is a spiral canal about 1½ inches long, and $\frac{1}{10}$ inch wide at its commencement, gradually tapering to the apex and making two-and-a-half turns in its course. It communicates with the tympanum by means of a round aperture (fenestra rotunda) which is closed in the natural state by a membrane. Its interior presents a central column (modiolus) around which winds the spiral lamina of bone. From the modiolus a bony lamina extends towards the outer wall but does not reach it: this is known as the osseous lamina spiralis. It divides each turn of the cochlea into an upper passage (scala vestibuli) and a lower (scala tympani). At the apex of the cochlea the two scalæ pass into one another by a small opening called the helicotrema.

The membranous labyrinth.

The bony labyrinth is lined throughout by periosteum, and contains an albuminous fluid called *perilymph*. Within each part of the bony labyrinth is a membranous structure analogous in shape to each corresponding part of the bony labyrinth, and called the membranous labyrinth. It is lined by a fluid called the *endolymph*. There is no communication between the perilymph and endolymph. The vibrations of the membrana tympani therefore being transmitted by the ossicles of the middle ear to the fenestra ovalis, directly affect only the perilymph. The fluctuations of this fluid pass from the vestibule on one side into the perilymph of the semicircular canals, and on the other side along the cochlea to its apex, and then by the helicotrema into the scala tympani, ending on the membrane closing the fenestra rotunda.

In the cochlea besides the two spaces known as the scala tympani and scala vestibuli, there is a third space called the scala media, which is formed at the modiolus by the membranous labyrinth, completing the division between the two other scalæ. In the interior of the scala media (or canalis membranacea) is the *organ of Corti*, a very complicated structure, containing numerous sets of nucleated cells, some furnished with stiff cilia or hairs, and freely supplied by the cochlear branch of the auditory nerve. It also contains curious strap-like structures known as the rods of Corti, about 8,700 in number and varying in length.

The three semicircular canals contain a membrane which is fixed to the inner periosteum by bands of fibrous tissue. A similar condition obtains in the vestibule, which is divided into two parts, a saccule and utricle. In all these parts the membrane is lined by a single layer of columnar epithelial cells, between which are wedged spindle-shaped cells. Each spindle-shaped cell is connected on its under surface to a nerve fibril, and projects beyond the free surface as a long stiff *auditory hair*.

Physiology of Internal Ear.

The sonorous vibrations passing along the perilymph occupying the coils of the cochlea, naturally affect on their way the membrane separating the cochlea from the scala media. Thus the vibrations are conveyed to the endolymph and affect the terminal organ of Corti. In the vestibule and semicircular canals there is a similar transmission of impulses to the sensory membrane in contact with endolymph. The organ of Corti, with its 8,000 or more rods of different lengths, a number more than sufficient to represent all the tones of the musical scale, has been regarded by Helmholtz as a kind of harp with its several thousand strings played upon as it were by the vibrations of sound; but inasmuch as the rods are absent in birds, which appear to be well able to distinguish diversities of tone, this theory must not be regarded as more than tentative.

The semicircular canals correspond in position to the three sides of a cube, and consequently sounds entering the ear from any particular direction will affect one of the canals more readily than the others. In this way some information as to the direction of sound is obtained. The semicircular canals appear also to play an important part in maintaining the erect posture of the body. Thus, section of the horizontal canal in a pigeon causes it to turn its head alternately to right and left for months afterwards. Section of the posterior vertical canal causes it to fall forward or backward; while lesion of the superior anterior canal also leads to vertical movements of the head. In the human being disease of the semicircular canals has been followed by similar effects.

(To be continued.)

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Easy Steps in Trigonometry.

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ANSWERS AND HINTS TO SOLUTIONS.

CHAPTER XX.

1. $\{\text{Cos}\,\theta + \sqrt{-1}\sin\theta\}^{\frac{1}{3}} = \cos\dfrac{\theta+2n\pi}{3} + \sqrt{-1}\sin\dfrac{\theta+2n\pi}{3}$

when n may be 0, 1, or 2

∴ the three values are

(i.) $\cos\dfrac{\theta}{3} + \sqrt{-1}\sin\dfrac{\theta}{3}$

(ii.) $\cos\dfrac{\theta+2\pi}{3} + \sqrt{-1}\sin\dfrac{\theta+2\pi}{3}$

(iii.) $\cos\dfrac{\theta+4\pi}{3} + \sqrt{-1}\sin\dfrac{\theta+4\pi}{3}$

2. $-1 = \cos(\pi+2n\pi) + \sqrt{-1}\sin(\pi+2n\pi)$

since $\sin(\pi+2n\pi) = 0$.

$\{-1\}^{\frac{1}{3}} = [\cos(\pi+2n\pi) + \sqrt{-1}\sin(\pi+2n\pi)]^{\frac{1}{3}}$

$= \cos\dfrac{\pi+2n\pi}{3} + \sqrt{-1}\sin\dfrac{\pi+2n\pi}{3}$

when n may be 0, 1, or 2

$\therefore (-1)^{\frac{1}{3}} = \cos\dfrac{\pi}{3} + \sqrt{-1}\sin\dfrac{\pi}{3}$, or $\cos\pi + \sqrt{-1}\sin\pi$,

or $\cos\dfrac{5\pi}{3} + \sqrt{-1}\sin\dfrac{5\pi}{3}$.

3. $\{\cos 4A \pm \sqrt{-1}\sin 4A\}^{\frac{1}{2}} = \cos 2A \pm \sqrt{-1}\sin 2A$.

4. $(-1)^{\frac{1}{3}} = [\cos(\pi+2n\pi) + \sqrt{-1}\sin(\pi+2n\pi.]^{\frac{1}{3}}$

proceed as in 2.

The 6 angles will be $\frac{\pi}{6}, \frac{\pi}{2}, \frac{5\pi}{6}, \frac{7\pi}{6}, \frac{3\pi}{2}, \frac{11\pi}{6}$.

5. $\{1+\sqrt{-1}\} = \sqrt{2}\left\{\dfrac{1}{\sqrt{2}} + \dfrac{\sqrt{-1}}{\sqrt{2}}\right\}$

$= \sqrt{2}\{\cos\theta + \sqrt{-1}\sin\theta\}$

where $\theta = \dfrac{\pi}{4} + 2n\pi$. n any integer.

$[\sqrt{2}\{\cos\theta + \sqrt{-1}\sin\theta\}]^{\frac{1}{3}} = 2^{\frac{1}{3}}\left\{\cos\dfrac{\theta}{3} + \sqrt{-1}\sin\dfrac{\theta}{3}\right\}$

where θ may be $\frac{\pi}{4}, \frac{\pi}{4}+2\pi, \frac{\pi}{4}+4\pi$.

or the three values are

(i.) $2^{\frac{1}{3}}\left\{\cos\dfrac{\pi}{12} + \sqrt{-1}\sin\dfrac{\pi}{12}\right\}$

(ii.) $2^{\frac{1}{3}}\left\{\cos\dfrac{3\pi}{4} + \sqrt{-1}\sin\dfrac{3\pi}{4}\right\}$

(iii.) $2^{\frac{1}{3}}\left\{\cos\dfrac{5\pi}{4} + \sqrt{-1}\sin\dfrac{5\pi}{4}\right\}$

6. Since $\tan\theta = \dfrac{b}{a}$. $\sin\theta = \dfrac{b}{\sqrt{a^2+b^2}}$, $\cos\theta = \dfrac{a}{\sqrt{a^2+b^2}}$

$(a+b\sqrt{-1})^{\frac{m}{n}} = (a^2+b^2)^{\frac{m}{2n}}\left\{\dfrac{a}{\sqrt{a^2+b^2}} + \sqrt{-1}\dfrac{b}{\sqrt{a^2+b^2}}\right\}^{\frac{m}{n}}$

$= (a^2+b^2)^{\frac{m}{2n}}\{\cos\theta + \sqrt{-1}\sin\theta\}^{\frac{m}{n}}$

$= (a^2+b^2)^{\frac{m}{2n}}\left\{\cos\dfrac{m}{n}\theta + \sqrt{-1}\sin\dfrac{m}{n}\theta\right\}$

Similarly

$(a-b\sqrt{-1})^{\frac{m}{n}} = (a^2+b^2)^{\frac{m}{2n}}\left\{\cos\dfrac{m}{n}\theta - \sqrt{-1}\sin\dfrac{m}{n}\theta\right\}$

Adding we obtain result asked for.

7. $\text{Sin}\,\theta = \theta - \dfrac{\theta^3}{6}$ very nearly (see Solution to Example 15 of Chapter XV.)

$\dfrac{\sin\theta}{\theta} = 1 - \dfrac{\theta^2}{6} = \dfrac{9999}{10000}$

$\therefore \dfrac{\theta^2}{6} = \dfrac{1}{10000}$

$\theta^2 = \dfrac{6}{10000}$

$\theta = \dfrac{1}{129}$

$\frac{1}{129}$ of $\dfrac{180}{\pi} = \frac{1}{129}$ of $57{\cdot}29\ldots = 3°$ nearly.

8. Since $x = \cos\theta + \sqrt{-1}\sin\theta$

$x^{-1} = \cos(-\theta) + \sqrt{-1}\sin(-\theta)$

$= \cos\theta - \sqrt{-1}\sin\theta$

$\therefore x + x^{-1} = 2\cos\theta$.

and $x - x^{-1} = 2\sqrt{-1}\sin\theta$.

9. By similar reasoning to that given in 8.

$x^n + x^{-n} = 2\cos n\theta$

and $x^n - x^{-n} = 2\sqrt{-1}\sin n\theta$.

10. $(x+x^{-1})^n = x^n + n.x^{n-2} + \dfrac{n(n-1)}{1.2}x^{n-4} + \ldots + nx^{-(n-2)} + x^{-n}$

which we can rearrange thus

$= (x^n + x^{-n}) + n(x^{n-2} + x^{-(n-2)}) + \ldots$

$= 2\cos n\theta + 2n\cos(n-2)\theta + \dfrac{2n(n-1)}{1.2}\cos(n-4)\theta + \ldots$

but $2^n\cos^n\theta = (x+x^{-1})^n$

= Expansion above

$\therefore 2^{n-1}\cos^n\theta = \cos n\theta + n\cos(n-2)\theta + \&c.$

let n = 6.

$\therefore 2^5\cos^6\theta = \cos 6\theta + 6.\cos 4\theta + \dfrac{6.5}{1.2}\cos 2\theta + \dfrac{6.5.4}{2(1.2.3)}$

11. In the Expansion in 10 let n = 5.

12. If n be even there are an odd number of terms in the expansion $(x + x^{-1})^n$ which will give us a middle term which in this case would be $\frac{6 \cdot 5 \cdot 4}{1 \cdot 2 \cdot 3} \cos 0$ which has to be divided by 2.

13. Draw the figure. By Form. 30 in the triangle AOB

$$l^2 = c^2 + m^2 - 2cm \cos \frac{B}{2}$$

$$\therefore \frac{1}{c}(l^2 - m^2) = c - 2m \cos \frac{B}{2}$$

$$\text{similarly } \frac{1}{a}(m^2 - n^2) = a - 2n \cos \frac{C}{2}$$

$$\text{and } \frac{1}{b}(n^2 - l^2) = b - 2l \cos \frac{A}{2}$$

Adding these equalities, we get our expression $= a + b + c - 2\left(m \cos \frac{B}{2} + n \cos \frac{C}{2} + l \cos \frac{A}{2}\right)$. Drop a perpendicular from O on BC and we see $a = m \cos \frac{B}{2} + n \cos \frac{C}{2}$; whence we can easily prove our proposition.

14. This problem was wrongly printed in the examples, and ought to have been if $2b = a + c$.

$$\text{prove } 2 \cot \frac{B}{2} = \cot \frac{A}{2} + \cot \frac{C}{2}$$

$$\text{If } 2b = a + c$$

$$2 \sin B = \sin A + \sin C$$

$$\therefore \sin B - \sin A = \sin C - \sin B$$

$$\therefore 2 \sin \frac{B - A}{2} \cdot \sin \frac{C}{2} = 2 \sin \frac{C - B}{2} \cdot \sin \frac{A}{2}$$

Expanding and dividing by $\sin \frac{A}{2} \cdot \sin \frac{B}{2} \sin \frac{C}{2}$, we get

$$\cot \frac{B}{2} - \cot \frac{A}{2} = \cot \frac{C}{2} - \cot \frac{B}{2}$$

$\therefore$ &c.

15. $$\sqrt{1 + \sin \theta} = \sqrt{\sin^2 \frac{\theta}{2} + 2 \sin \frac{\theta}{2} \cos \frac{\theta}{2} + \cos^2 \frac{\theta}{2}}$$

$$= \sin \frac{\theta}{2} + \cos \frac{\theta}{2}$$

$$= \sin \frac{\theta}{2} + 1 - 2 \sin^2 \frac{\theta}{4} \quad \text{Form. 10.}$$

$$= 1 + 2 \sin \frac{\theta}{4} \cos \frac{\theta}{4} - 2 \sin^2 \frac{\theta}{4}$$

$$= 1 + 2 \sin \frac{\theta}{4}\left(\cos \frac{\theta}{4} - \sin \frac{\theta}{4}\right)$$

$$= 1 + 2 \sin \frac{\theta}{4} \sqrt{1 - \sin \frac{\theta}{2}}$$

16. $$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$\therefore \frac{a + b + c}{\sin A + \sin B + \sin C} = \frac{a}{\sin A}$$

$$\therefore a = \frac{(a + b + c) \sin A}{\sin A + \sin B + \sin C}$$

but $(a + b + c)$ is given as well as sin A, &c.

17. Let CAD represent a vertical section through the path. A the spot whence he started. C the top. D vertically beneath C in the same horizontal plane with A. Let B be the spot where the inclination of the path increased. Through B draw BE horizontal to CD. BAD $= \theta$; CBE $= \phi$; CAD $= x$; and CD $= m$. We can easily prove that ACB $= (\phi - x)$ and BAC $= (x - \theta)$ and AC $= m$ cosec x, whence we can solve the triangle CBA and prove AB + BC or the path

$$= m \frac{\cos\left[\frac{1}{2}(\theta + \phi) - x\right]}{\sin x \cos \frac{1}{2}(\theta - \phi)}$$

18. Let A, B, and C be the centres of the circles whose radii are a, b, and c respectively, and let AB cut the circles at D and let O be the point where the tangents meet.

$$\therefore \text{OD} = a \tan \frac{A}{2}.$$

If $2s$ = the sum of the three sides of the triangle ABC; in this particular case $s = a + b + c$, and in formulæ 33 and 34, from which we get $\tan \frac{A}{2}$, we must write $(b + c)$, $(c + a)$ and $(a + b)$ for a, b, c respectively.

$$\therefore \text{OD} = a \sqrt{\frac{bc}{(a + b + c)a}} = \sqrt{\frac{abc}{a + b + c}}$$

19. $\text{Sin } \theta - \cos \theta = 4(1 - \sin^2 \theta) \sin \theta$

$$\therefore -\cos \theta = 3 \sin \theta - 4 \sin^3 \theta$$

$$= \sin 3\theta.$$

$$= -\cos\left(3\theta + \frac{\pi}{2}\right)$$

$$\therefore \theta = -\frac{\pi}{4} \text{ or } 2n\pi \mp \frac{\pi}{4}.$$

20. Expand and divide by $\sin a \sin \theta$; collecting we get $(1 + \tan \theta)(\tan a - 1) = 0$

$$\therefore \tan \theta = -1 \text{ or } \theta = \frac{3\pi}{4} \text{ or } n\pi + \frac{3\pi}{4}.$$

21. $\text{Cot}^{-1}(1 + 1 + 1^2) = \tan^{-1} \frac{1}{1 + 1 + 1^2}$

see Example 18 of Chapter XIX. whence sum

$$= \frac{\pi}{4} - \tan^{-1} \frac{1}{3} = \tan^{-1} \frac{2}{4}.$$

22. Since $\sin^2 A + \sin^2 B = \sin^2 C$

$$\therefore a^2 + b^2 = c^2$$

$\therefore C = 90° = A + B$. Euclid I. 48.

23. Let the line which bisects c meet it in D, then from the triangle CDB.

$$l^2 = a^2 + \frac{c^2}{4} - ac \cos B$$

$$= a^2 + \frac{c^2}{4} - ac \cdot \frac{a^2 + c^2 - b^2}{2ac}$$

$$= \frac{4a^2 + c^2 - 2a^2 - 2c^2 + 2b^2}{4}$$

$$\therefore l = \tfrac{1}{2}\sqrt{2(a^2 + b^2) - c^2}$$

24. $$\frac{c}{b} = \frac{\sin C}{\sin B}.$$

$$\therefore \frac{c + b}{c - b} = \frac{\sin C + \sin B}{\sin C - \sin B}$$

$$= \frac{\cos \frac{A}{2} \cdot \cos \frac{C - B}{2}}{\sin \frac{A}{2} \cdot \sin \frac{C - B}{2}}$$

$$\therefore \frac{c + b}{c - b} \tan \frac{A}{2} = \frac{\cos \frac{C - B}{2}}{\sin \frac{C - B}{2}}$$

$$\text{but } \cos \frac{C - B}{2} = \sin\left(90 - \frac{C - B}{2}\right)$$

$$= \sin \frac{A + B + C - C + B}{2}$$

$$= \sin\left(B + \frac{A}{2}\right)$$

similarly treat the sine $\frac{C - B}{2}$.

25. $x = -4\frac{1}{3}1$.

CHAPTER XXI.

THE CONSTRUCTION OF TRIGONOMETRICAL TABLES.

279. In chapter 15, paragraphs 216 and 217, we showed that sin θ, θ, and tan θ, are in order of magnitude, and that if the angle be indefinitely diminished

Sin $\theta = \theta =$ tan θ — (θ being the circular measure of the angle.)

280. The equalities referred to in 279 are generally stated thus:—

$$\text{If } \theta = 0\text{; limit of } \frac{\sin\theta}{\theta} = 1.$$

$$\text{" " } \frac{\sin\theta}{\tan\theta} = 1.$$

$$\text{" " } \frac{\theta}{\tan\theta} = 1.$$

281. In No. 15 of the examples to chapter 15, we gave as an example the theorem, that if θ be the C.M. of an angle less than 90°.

θ, $\sin\theta$, and $\left(\theta - \frac{\theta^3}{\theta}\right)$ are in order of magnitude, the proof of which will be found in the solutions.

282. The limit of $m \sin\frac{a}{m}$ when m is *increased* indefinitely is a, for as m is increased indefinitely, $\frac{a}{m}$ is decreased indefinitely.

$$\therefore m \sin\frac{a}{m} = m \cdot \frac{a}{m} \cdot \frac{\sin\frac{a}{m}}{\frac{a}{m}}$$

$$= m \cdot \frac{a}{m} = a$$

$$\text{Since } \frac{\sin\frac{a}{m}}{\frac{a}{m}} \left(\text{when } \frac{a}{m} = 0\right) = 1.$$

283. If the angle be not expressed in C. M. we must reduce it to C.M. since the limit of $\frac{\sin\theta}{\theta}$, as θ is indefinitely diminished, is only = 1, if θ be the C.M.

To find the limit of $\frac{\sin n^\circ}{n}$

Let θ = C.M. of n°.

$$\therefore n = \frac{180}{\pi} \cdot \theta$$

$$\text{Limit of } \frac{\sin n}{n} = \frac{\sin\theta}{\frac{180^\circ}{\pi}\theta} = \frac{\pi}{180^\circ} \cdot \frac{\sin\theta}{\theta}$$

but as n decreases so does θ,

∴ when n is indefinitely decreased

$$\text{since } \frac{\sin\theta}{\theta} = 1$$

$$\text{the limit of } \frac{\sin n^\circ}{n} = \frac{\pi}{180^\circ}$$

or the circular measure of 1 degree.

284. We are now in a position to find approximately the sine of 10″.

$$\text{C.M. of } 10'' \text{ is } \frac{10\pi}{180 \times 60 \times 60} \text{ or } \frac{\pi}{64800}$$

$$\therefore \text{Sine of } 10'' \text{ is less than } \frac{\pi}{64800}$$

$$\text{and greater than } \frac{\pi}{64800} - \tfrac{1}{3}\left(\frac{\pi}{64800}\right)^3 \quad \text{Par. 281.}$$

Let us take for our value of π, 3·141592653590.

$$\text{C. M. of } 10'' = \frac{3{\cdot}141592653590}{64800}$$

$$= {\cdot}000048481368$$

$$\tfrac{1}{3}({\cdot}000048481368)^3 = {\cdot}000000000000032.$$

∴ The quantity to be subtracted from C.M. of 10″ does not affect the first twelve figures of the decimal, hence as far as twelve figures of decimals

Sin 10″ = C.M. of 10″ = ·000048481368.

285. The student can easily obtain for himself the value of cos 10″.

viz.—·99999998824.

286. Since $\sin(A + B) + \sin(A - B) = 2 \sin A \cos B$,

$$\sin(A + B) = 2 \sin A \cos B - \sin(A - B)$$

Let A = 10″ and B = 10″.

Sin 20″ = 2 sin 10″ cos 10″, but we know sin 10″ and cos 10″ and ∴ can find sin 20″.

Similarly, we could from sin 20″, sin 10″, and cos 10″, find sin 30″, and hence sin 40″, &c., &c.

287. In the formula in 286

Let A = n 10″ and B = 10″.

∴ Sin (n + 1) 10″ = 2 sin n 10″ cos 10″ − sin (n − 1) 10″ for 2 cos 10″ write 2 − k.

∴ Sin (n + 1) 10″ = (2 − k) sin n . 10″ − sin (n − 1) 10″.

∴ Sin (n + 1) 10″ − sin n 10″ = sin n 10″ − sin (n − 1) 10″ − k sin n 10″.

$$k = 2(1 - \cos 10'')$$

$$= 2({\cdot}000000001175)$$

$$= {\cdot}000000002350.$$

Since k is very small the work is not so laborious as one might have expected.

288. Though we have calculated the sine of 10″ to 12 places of decimals, we must not suppose that by the method adopted in the former paragraphs we shall have the sines of larger angles correct to 12 places of decimals.

289. When we come to some aliquot part of a right angle, or of 60°, or of 18°, we might compare the sine obtained as above with the sine obtainable by other formulæ.

290. The two following formulæ are called formulæ of verification, because they can be used at any time to verify any part of the calculated tables.

$$\sin A + \sin(72^\circ + A) - \sin(72^\circ - A) = \sin(36^\circ + A) - \sin(36 - A)$$

$$\cos A + \cos(72^\circ + A) + \cos(72^\circ - A) = \cos(36^\circ + A) + \cos(36^\circ + A)$$

291. To prove the former of these two formulæ.

$$\sin(72^\circ + A) - \sin(72^\circ - A) = 2 \cos 72^\circ \sin A$$

$$= \frac{\sqrt{5} - 1}{2} \sin A. \quad \text{See Chap. 16, Ex. 21.}$$

$$\sin(36 + A) - \sin(36^\circ - A) = 2 \cos 36^\circ \sin A$$

$$= \frac{\sqrt{5} + 1}{2} \sin A$$

$$\therefore \text{Sin A} + \sin(72^\circ + A) - \sin(72^\circ - A)$$
$$= \sin A + \frac{\sqrt{5}-1}{2} \sin A$$
$$= \frac{\sqrt{5}+1}{2} \sin A$$
$$= \sin(36^\circ + A) - \sin(36^\circ - A)$$

292. The last 12 examples in the following collection are of a miscellaneous character, and worthy of the student's attention.

293. Examination and Exercises XXI.

1. Prove that the limit of $m \tan \frac{a}{m}$, as m increases indefinitely is a.

2. Prove that the limit of $\frac{\sin n'}{n}$, as n is indefinitely diminished, is the C. M. of 1 minute.

3. If θ (C. M.) lie between 0 and $\frac{\pi}{2}$ prove $\frac{\theta}{2} - \frac{\theta^3}{32}$, θ, $\sin\frac{\theta}{2}$ are in ascending order of magnitude.

4. If θ (C. M.) lie between 0 and $\frac{\pi}{2}$ prove $\cos\theta$ is less than $1 - \frac{\theta^2}{2} + \frac{\theta^4}{16}$.

5. Prove $\sin(45^\circ + A) = \sqrt{2}\sin A + \sin(45^\circ - A)$.

6. Show how to apply the formula in Exercise 5, to find the natural sines of angles between 45° and 90° from those between 0 and 45°.

7. Prove the second formula of verification given in par. 290.

8. Prove $\sin(60^\circ + A) = \sin A + \sin(60^\circ - A)$.

9. Of what angles would this formula verify the natural sines.

10. If you had all the natural sines, cosines, and tangents calculated from 10° to 45°, how could you obtain all the other natural sines &c.?

Verify the following extracts from the tables.

11. Sin 62° = ·8829476.

12. Cos 42° = ·6691306.

13. From sin 3° = ·0523360 and sin 57° = ·8386706, obtain natural sine of 63°.

14. If $\tan\frac{\theta}{2} = \frac{\tan\theta + c - 1}{\tan\theta + c + 1}$ Express $\tan\frac{\theta}{2}$ in terms of c.

15. If $m = \operatorname{cosec}\theta - \sin\theta$
$n = \sec\theta - \cos\theta$
Prove $(mn)^{\frac{2}{3}}(m^{\frac{2}{3}} + n^{\frac{2}{3}}) = 1$.

16. Eliminate x and y from the equations
$\tan x + \tan y = a$
$\cot x + \cot y = b$
$x + y = c$.

17. If two circles whose radii are a and b touch each other externally, and if θ be the angle contained by the two common tangents to these circles, show that
$$\sin\theta = \frac{4(a-b)\sqrt{ab}}{(a+b)^2}$$

18. Given $\sec\alpha\sec\theta + \tan\alpha\tan\theta = \sec\beta$, find $\tan\theta$.

19. If $a\sin^2\theta + b\cos^2\theta = c$
$b\sin^2\phi + a\cos^2\phi = d$
$a\tan\theta = b\tan\phi$
Prove $\frac{1}{c} + \frac{1}{d} = \frac{1}{a} + \frac{1}{b}$

20. Find the limit, when θ is indefinitely diminished, of
$$\frac{\tan^2\theta}{\sec 2\theta - 1}$$

21. Eliminate α and β from the equations
$a = \sin\alpha\cos\beta\sin\theta + \cos\alpha\cos\theta$
$b = \sin\alpha\cos\beta\cos\theta - \cos\alpha\cos\theta$
$c = \sin\alpha\sin\beta\sin\theta$.

22. If $y\cos\phi - x\sin\phi = a\cos 2\phi$
$y\sin\phi + x\cos\phi = 2a\sin 2\phi$
show $(x+y)^{\frac{2}{3}} + (x-y)^{\frac{2}{3}} = 2a^{\frac{2}{3}}$.

23. If $\frac{\cos x}{a} = \frac{\cos 2x}{b} = \frac{\cos 3x}{c}$
Prove $\frac{2b - a - c}{4b} = \sin^2\frac{x}{2}$.

24. If $\frac{\sin x}{a} = \frac{\sin 3x}{b} = \frac{\sin 5x}{c}$
prove $\frac{a - 2b + c}{b} = \frac{b - 3a}{a}$

25. From one of the angles of a rectangle a perpendicular is drawn to its diagonal (c), and from the point of their intersection perpendiculars p and q are drawn to the sides which contain the opposite angle.
Prove $p^{\frac{2}{3}} + q^{\frac{2}{3}} = c^{\frac{2}{3}}$.

(To be continued.)

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Mental Arithmetic, its Principles and Practice.

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ANSWERS TO EXERCISES.

CHAPTER XII.

1. 4s. 2d. = 50d. = $\pounds\frac{5}{24} = \pounds\frac{10}{48}$.
hence add on a cypher and divide by 48.

2. £31 5s. = $\pounds31\frac{1}{4} = \pounds\frac{125}{4} = \pounds\frac{1000}{32}$.
hence add on three cyphers and divide by 32.

3. 19s. 2d. = $\pounds\frac{958}{960} = \pounds\frac{959}{960} = \pounds\frac{960}{960} - \pounds\frac{1}{960}$.
hence subtract $\frac{1}{960}$ of the number from the number and call them pounds.

4. 2s. $1\frac{1}{2}$d. = $\pounds\frac{9}{160} + \frac{1}{80}$s. = $\pounds\frac{1}{10} + \frac{1}{80}$s.
hence, take $\frac{1}{10}$ of the number and call them pounds, and then take $\frac{1}{80}$ of the number and call them shillings, and add the two results.

5. 4s. 7d. = 5s. — 5d. = $\pounds\frac{5}{20} - \frac{5}{12}$s. = $\pounds\left(\frac{1}{4} - \frac{1}{4\cdot12}\right)$,
hence take $\frac{1}{4}$ of the number, and from this subtract $\frac{1}{12}$ of that $\frac{1}{4}$, and call these pounds.

6. $6\frac{1}{2}$d. = 6d. + $\frac{1}{2}$d. = $\frac{1}{2}$s. + $\frac{1}{24}$d.
hence, take half the number and call them shillings, and add on the same number of pence.

7. 1s. $3\frac{3}{4}$d. = 1s. 3d. + $\frac{3}{4}$d. = $\pounds\left(\frac{15}{240} + \frac{3}{4\cdot240}\right) = \pounds\left(\frac{1}{16} + \frac{1}{20\times16}\right)$.
hence, take $\frac{1}{16}$ and call them pounds, and add on the same number of shillings.

8. 3s. 9d. = $\pounds\frac{45}{240} = \pounds\frac{3}{16} = \pounds\left(\frac{2}{16} + \frac{1}{16}\right) = \pounds\left(\frac{1}{8} + \frac{1}{8\cdot2}\right)$.
hence, take $\frac{1}{8}$ and add half this number and call them pounds.

9. 2s. $7\frac{1}{2}$d. = $\pounds\frac{31\frac{1}{2}}{240} = \pounds\frac{63}{480} = \pounds\left(\frac{60}{480} + \frac{3}{480}\right) = \pounds\left(\frac{1}{8} + \frac{1}{20\times8}\right)$.
hence, take $\frac{1}{8}$ and call them pounds, and add on the same number of shillings.

10. 3s. $1\frac{1}{2}$d. = $\pounds\frac{37\frac{1}{2}}{240} = \pounds\frac{75}{480} = \pounds\frac{5}{32} = \pounds\frac{10}{64}$.
hence, add on a cypher, and divide by 64;
or since $\pounds\frac{5}{32} = \pounds\left(\frac{4}{32} + \frac{1}{32}\right) = \pounds\left(\frac{1}{8} + \frac{1}{8\times4}\right)$, we can take $\frac{1}{8}$, call them pounds, and add on $\frac{1}{4}$ of this number of pounds.

11. £106 13s. 4d.
12. £9906 5s.
13. £202 4s. 2d.
14. £39 16s. 10½d.
15. £109 1s. 8d.
16. £8 17s. 1½d.
17. £16 19s. 11¼d.
18. £61 6s. 3d.
19. £53 18s. 10½d.
20. £51 1s. 10½d.
21. £125.
22. £97 13s. 4d.
23. £753 6s. 8d.
24. £128.
25. £300 8s. 5¼d.
26. £424 3s. 4d.
27. £17,785 16s. 8d.
28. £31,415.
29. £31,013 6s. 8d.
30. £793 6s. 8d.
31. £744 1s. 3d.
32. £1,849 7s. 6d.
33. £1,338 2s. 6d.
34. £5,486 5s.
35. £455,350.
36. £2,968,916 13s. 4d.
37. £14,750.
38. £4,344 13s. 4d.
39. £4,661 16s. 3d.
40. £1,009 16s. 0½d.
41. £2,136 0s. 6¾d.
42. £3,954 4s.
43. £4,116 7s. 1½d.
44. £469 14s. 10½d.
45. £1,313 11s. 8d.
46. £9,268 14s. 2½d.
47. £2,455 17s. 6d.
48. £18,178 14s. 6d.
49. £37,314 4s. 6d.
50. £3,570 11s. 2d.

CHAPTER XIII.

1. £23 12s. 7½d.
2. £4 5s. 3½d.
3. £6 5s. 5½d.
4. £3 0s. 2¾d.
5. £53 19s. 8½d.
6. £28 0s. 9¼d.
7. £37 3s. 7¼d.
8. £82 6s. 4½d.
9. £17 9s. 8¾d.
10. £19 11s. 11¾d.
11. £301 2s. 4d.
12. £225 2s. 6d.
13. £329 0s. 7d.
14. £46 8s. 6¾d.
15. £3 17s. 6¾d.
16. £4 3s. 8¾d.
17. £61 11s. 3d.
18. £38 10s. 3¾d.
19. £243.
20. £71 2s.
21. £15 17s. 3d.
22. £240 6s.
23. £12 10s.
24. £175 5s. 10d.
25. £12 10s. 1d.
26. £166 13s. 4½d.
27. £128 4s.
28. £31 4s. 2¼d.
29. £21 0s. 1½d.
30. £2 1s. 1d.
31. £20,011 1s. 1d.
32. £42 16s. 3¼d.
33. £212 1s. 2d.
34. £697 5s.
35. £2 1s. 6½d.
36. £5 2s. 8d.
37. £2,010.
38. £21 13s. 2¼d.
39. £1,394 0s. 8¾¾d.
40. £41.
41. £48.
42. £127 15s.
43. £29 14s.
44. £11 11s. 2d.
45. £1 14s. 3d.
46. £2 0s. 10d.
47. £4 12s. 1d.
48. £8 5s.
49. £$\frac{1}{91{\cdot}365{\cdot}100}$, or £$\frac{1}{3,321,500}$.
50. The difference on each pound is $\frac{8}{8,833}$s; ∴ the least amount would be £1,104.

In Example 36 of the above we must read 4d. for 9d. to get the answer here given.

CHAPTER XIV.

1. £238 2s.
2. £897 8s. 4d.
3. £751 4s. 2d.
4. £1,897 13s. 4d.
5. £232 4s. 9½d.
6. £1,379 8s. 6½d.
7. £837 14s. 2d.
8. £346 17s. 4d.
9. £393 18s. 8d.
10. £601 8s.
11. £702 6s. 6d.
12. £940 7s. 10d.
13. £3,540 9s. 10d.
14. £696 16s, 11d.
15. £924 6s. 5d.
16. £460 7s. 8d.
17. £180 10s.
18. £241.
19. £280 6s. 8d.
20. £330 17s. 6d.
21. £960 13s. 4d.
22. £384 14s.
23. £250.
24. £250 2s. 1d.
25. £510 5s.
26. £3,032 6s. 8d.
27. £225 10s. 5d.
28. £3,160 7s. 6d.
29. 2 per cent.
30. 5 per cent.
31. 4 per cent.
32. 4 per cent.
33. 10 per cent.
34. 6¼ per cent.
35. £780 2s. 2d.
36. £701 5s. 8d.
37. £2,180 9s. 1d.
38. £4,058 18s. 2d.
39. £845 4s. 1d.
40. £1,148 4s. 8d.
41. 1 per cent. on £1,000 16s. 8d. = £10 0s. 2d.
42. $\frac{1}{25}$ of £960 4s. = £20 0s. 1d.
43. £21 5s. 10d. × $\frac{240}{1}$ = £730.
44. £3 0s. 1d. × $\frac{240}{1}$ = £360 10s.
45. $\frac{\text{£2 0s. 1d.}}{\text{£481}} = \frac{1}{240}$. ∴ Ans. 1d.
46. $\frac{100}{100} - \frac{96}{100} = \frac{4}{100}$ ∴ Ans. £2 0s. 1d.
47. $\frac{98}{100} - \frac{96}{100} = \frac{2}{100}$. ∴ Ans. £2 0s. 7d.
48. £4 4s.
49. 2½ per cent.
50. $\frac{4}{41}$.

CHAPTER XV.

DISCOUNT.

152. The true discount on a sum of money due some time hence is the difference between the sum and its present value.

153. We can, however, find the discount without finding the present value.

154. At 5 per cent. one year hence, £100 will be worth £105; the discount, therefore, on £105 for one year at 5 per cent. is £5, and therefore on any other sum of money for the same time and at the same rate will be that sum of money multiplied by $\frac{5}{105}$ or $\frac{1}{21}$.

155. If in finding the interest for a given time at a given rate we can reduce the fraction, by which we have to multiply the principal, to one whose numerator is 1, and whose denominator is a whole number; to find the discount for the same time and at the same rate, all we have to do is to increase the denominator by 1 and multiply by the resulting fraction; *e.g.*, to find the interest for three months at 8 per cent., we multiply the principal by $\frac{\frac{3}{12} \times 8}{100}$ or $\frac{1}{50}$; therefore to find the discount for three months at 8 per cent. we must multiply the sum of money by $\frac{1}{51}$.

156. Even if the multiplying fraction cannot be reduced to one whose denominator is 1 and whose numerator is an integer, we can still reduce the fraction to one whose numerator is 1, and to the denominator, even though it is a fraction, add 1; *e.g.*, What is the discount on £1,242 17s. 3d. for seven months at 6 per cent.? The fraction by which we shall have to multiply, to find the interest, is $\frac{\frac{7}{12} \times 6}{100}$ or $\frac{7}{200}$. This we can reduce thus: $\frac{1}{28\frac{4}{7}}$; ∴ the fraction by which we must multiply to obtain the discount is $\frac{1}{29\frac{4}{7}}$, or $\frac{7}{207}$, which immediately suggests the rule of adding the numerator to the denominator for the denominator of the fraction we want. The answer to the above would be £42 0s. 7d.

157. If to find the discount on a certain sum of money we multiply it by any fraction as $\frac{1}{51}$; to find the principal from the discount, we must multiply the discount by the reciprocal of $\frac{1}{51}$ or 51; *e.g.*, on what sum of money is £3 the discount for eight months calculated at the rate of 3 per cent. per annum? Our multiplying fraction for interest is $\frac{\frac{8}{12} \times 3}{100}$, or $\frac{1}{50}$. ∴ the multiplying fraction for discount is $\frac{1}{51}$, and ∴ the sum of money on which the discount amounts to £3 is £3 × 51 or £153.

158. Since the discount on a sum of money is really the interest on its present value, and the interest on the same sum may be considered the interest on its future value, the difference between the interest and the discount is the interest on the difference of the present and future values, which is the discount; hence, if we know this difference we know the interest on the discount, from which we can find the principal.

159. If the difference between the interest and the discount is £1, the time being four months, and the rate six months, the fraction to find the interest is $\frac{6 \times 4}{100}$ or $\frac{1}{20}$. ∴ the discount is £50, and the sum of money on which the discount and interest are calculated is 51 × 50 or £2,550.

160. In many of the Government Papers I notice, no time is mentioned, nor is the rate per cent. given as a rate per cent. per annum; in such cases of course one period as one year can be understood.

161. EXAMPLES XV.

Find the fractions by which we must multiply the principal to find the discount for the specified times and rates in the following 10 examples.

1. For 10 months at 6 per cent.
2. 1 year at 3½ ,,
3. 8 months at 15 ,,
4. 2 ,, at 5 ,,
5. 5 ,, at 3½ ,,
6. 10 ,, at 2½ ,,
7. 15 ,, at 8 ,,
8. 15 ,, at 6 ,,
9. 7 ,, at 5 ,,
10. 5 ,, at 7 ,,

In the following 20 examples find the discount on the sums for the given times at the given rates per annum.

11. £847 2s. 3d. for 12 months at 4 per cent.
12. £812 15s. 5d. for 12 ,, at ,,
13. £846 1s. 8d. for 12 ,, at 4 ,,
14. £243 10s. 3d. for 12 ,, at 5 ,,
15. £462 5s. 6d. for 12 ,, at 2½ ,,
16. £388 19s. 9d. for 12 ,, at 2½ ,,
17. £475 8s. 7d. for 12 ,, at 2½ ,,
18. £119 4s. 4½d. for 12 ,, at 5 ,,
19. £137 13s. 7½d. for 12 ,, at 5 ,,
20. £217 7s. for 12 ,, at 5 ,,
21. £786 12s. 2d. for 12 ,, at 4 ,,
22. £430 11s. 9d. for 12 ,, at 5 ,,
23. £56 7s. 9d. for 12 ,, at 4 ,,
24. £71 7s. 1½d. for 12 ,, at 5 ,,
25. £81 5s. for 8 ,, at 6 ,,
26. £148 2s. 9d. for 10 ,, at 6 ,,
27. £104 9s. 11d. for 12 ,, at 3½ ,,
28. £156 10s. 10½d. for 8 ,, at 15 ,,
29. £617 17s. 1½d. for 2 ,, at 5 ,,
30. £165 0s. 4½d. for 10 ,, at 2½ ,,

On what sums of money are the ten following sums the discount, for the times and at the rates per annum specified.

31. £2 3s. 4d. for 10 months at 6 per cent.
32. £5 7s. 9½d. for 12 ,, at 3½ ,,
33. £3 8s. 7½d. for 8 ,, at 15 ,,
34. £6 2s. 3d. for 2 ,, at 5 ,,
35. £7 4s. 7½d. for 5 ,, at 3½ ,,
36. £4 8s. 6½d. for 10 ,, at 2½ ,,
37. £11 13s. 9½d. for 15 ,, at 8 ,,
38. £9 6s. 3½d. for 15 ,, at 6 ,,
39. £14 14s. 1½d. for 7 ,, at 5 ,,
40. £28 17s. 2½d. for 15 ,, at 6 ,,

Find the difference between the interest and the discount on the five following sums for the times and at the rates per cent. per annum specified.

41. £27 1s. 8d. for 12 months at 4 per cent.
42. £84 3s. 4d. for 4 ,, at 3 ,,
43. £29 8s. for 5 ,, at 5 ,,
44. £48 8s. for 3 ,, at 12½ ,,
45. £129 16s. 8d. for 9 ,, at 3½ ,,

Find the sums of money of which the interest and the discount differ by the five following sums for the times and at the rates per annum specified.

46. 1s. 6d. Time 3 months. Rate 4 per cent.
47. 4d. Time 4 months. Rate 3½ per cent.
48. 7d. ,, 4 ,, ,, 6 ,,
49. 1s. 8d. Time 5 months. Rate 8 per cent.
50. 3d. Time 73 days. Rate 5 per cent.

CHAPTER XVI.

BANKERS' DISCOUNT AND PRESENT WORTH.

162. Bankers when they discount a bill do not charge the true discount, as explained in the last chapter, but the interest on the sum of money.

163. In the Government Papers, candidates, I see, are frequently asked to calculate the true discount from the banker's discount and *vice versa*, but the time, if not stated, must be considered as one period; *e.g.*, if the discount on a certain sum of money, which need not be known, is £17 6s. 8d., interest being calculated at 5 per cent., what is the banker's discount or interest? Here we understand that the period to be calculated for is the period for which £5 is the price for the use of £100.

The discount is $\frac{1}{21}$ of the principal, or the principal is 21 times the discount, but the interest is $\frac{1}{20}$ of the principal. ∴ the interest is $\frac{21}{20}$ of the discount. ∴ if £17 6s. 8d. is the discount £18 4s. is the interest or banker's discount.

164. Since $\frac{21}{20} = 1 + \frac{1}{20}$ for 5 per cent. for one period, to obtain the banker's discount from the true discount we add on $\frac{1}{20}$ of it, which is a rule found in most text books.

165. To obtain the true discount from the interest or banker's discount when calculated at 5 per cent. for one period, we must not, as some students might, without thought, suppose, subtract $\frac{1}{20}$ of it from it, but $\frac{1}{21}$ as we will show—

Since interest = $\frac{21}{20}$ of discount
discount = $\frac{20}{21}$ of interest
= $(\frac{21}{21} - \frac{1}{21})$ of interest,

or the interest less $\frac{1}{21}$ of that.

166. The present worth, though practically discussed in an earlier chapter, is so connected with the subject of discount, being the sum of money paid over the counter to the man whose bill is being discounted, that we return to it here.

167. What sum of money shall I receive for a bill drawn for three months at 16 per cent. per annum, if I discount it immediately it is drawn, the amount of the bill being £554 5s. 9d. Since £100 now is worth $100 + 100 \times \frac{3 \times 16}{12 \times 100}$ or £104, at the end of the three months, to find the present worth of £554 5s. 9d. I must multiply it by $\frac{100}{104}$ or $\frac{25}{26}$, which gives me £532 19s. 4½d.

168. The easiest way to multiply by $\frac{25}{26}$ is to reduce $\frac{25}{26}$ to $\frac{26}{26} - \frac{1}{26}$, or to subtract $\frac{1}{26}$ of the sum from the sum, which is of course subtracting the discount from the principal, which we know to be the present worth.

169. Similarly, to obtain the future value from the present worth, we must multiply by $\frac{26}{25}$ or $\frac{25}{25} + \frac{1}{25}$, or add $\frac{1}{25}$ of the sum to the sum itself.

170. In the chapter on interest the present worth was called the principal, and the future value the amount, whereas in a question of discount or present worth this amount is called the principal or the sum.

171. EXAMPLES XVI.

In the ten following questions find the true discount from the given banker's discount, or interest, for the times and at the rates per cent. per annum specified.

1. £8 6s. 3d. for 12 months at 5 per cent.
2. £5 15s. 6d. for 12 ,, at 5 ,,
3. £32 14s. 6d. for 12 ,, at 5 ,,
4. £71 18s. 7d. for 4 ,, at 5 ,,
5. £217 for 6 ,, at 10 ,,
6. £133 18s. 11d. for 5 ,, at 4 ,,
7. £134 10s. 7½d. for 9 ,, at 3½ ,,
8. £291 6s. 6⅔d. for 73 days at 10 per cent.
9. £212 7s. 10½d. for 3 months at 8 per cent.
10. £102 0s. 11½d. for 9 ,, at 6⅔ ,,

In the ten following cases find the banker's discount from the given true discount for the times and at the rates per cent. per annum specified.

11. £46 15s. for 3 months at 3½ per cent.
12. £161 5s. for 5 ,, at 5 ,,
13. £100 15s. 7½d. for 6 ,, at 6⅔ ,,
14. £296 7s. 6d. for 5 ,, at 6 ,,
15. £107 2s. 9⅔d. for 10 ,, at 8 ,,
16. £272 17s. 1d. for 7 ,, at 3½ ,,
17. £86 10s. 2½d. for 11 ,, at 4⅔ ,,
18. £114 0s. 2½d. for 13 weeks at 8 ,,
19. £646 9s. 2d. for 73 days at 2½ per cent.
20. £1,265 for 5 days at 6⅓ ,,

In the ten following cases find the present worth of the sums specified, for the times and at the rates per annum placed against them.

21. £315 2s. 9d. due 4 months hence, 6 rate per cent.
22. £324 11s. 4d. due 12 ,, ,, 4 ,,
23. £812 15s. 5d. due 3 ,, ,, 16 ,,
24. £422 2s. 3½d. due 10 ,, ,, 2½ ,,
25. £3,638 17s. 10d. due 12 ,, ,, 7 ,,
26. £171 5s. 6d. due 4 ,, ,, 6 ,,
27. £238 8s. 0½d. due 73 days hence, 5 ,,
28. £179 13s. 4d. due 73 ,, ,, 33⅓ ,,
29. £5,139 5s. 7d. due 5 ,, ,, 6⅓ ,,
30. £320 13s. 9d. due 7½ weeks ,, 7 ,,

Find the amounts of the following bills for which the discounter receives the specified sums, the bills being discounted (banker's discount) at the times before they are due, and at the rates placed against each.

31. £1,575 16s. 11d. for 219 days at 5 per cent.
32. £3,663 for 3 months at 4 per cent.
33. £1,732 1s. 9d. for 73 days at 5 per cent.
34. £215 6s. 3d. for 5 months at 6 per cent.
35. £305 3s. 11d. for 2 ,, at 6⅔ ,,
36. £333 6s. 0d. for 4 ,, at 3 ,,
37. £215 8s. 11d. for 5 ,, at 8 ,,
38. £730 2s. 6d. for 7 ,, at 2⅔ ,,
39. £215 16s. 0d. for 9 ,, at 3⅓ ,,
40. £545 19s. 8d. for 10 ,, at 2½ ,,

Find the amounts for which the following bills were drawn, for which the discounter received the specified sums at the times before they are due, and at the rates placed against each, true discount being reckoned.

41. £8,721 16s. 8d. for 3 months at 2½ per cent.
42. £4,575 for 9 ,, at 5½ ,,
43. £150 12s. 6d. for 4 ,, at 4 ,,
44. £5,600 for 9 ,, at 3½ ,,
45. £1,333 6s. 8d. for 3 ,, at 7 ,,
46. £216 17s. 6d. for 6 ,, at 8 ,,
47. £4,000 8s. 4d. for 9 ,, at 4 ,,
48. £1,820 for 3 ,, at 5 ,,
49. £356 5s. for 18 ,, at 4 ,,
50. £200 15s. for 25 days at 3½ ,,

(73 is contained in 4015 55 times).

CHAPTER XVII.

PER CENTAGES. PROFIT AND LOSS.

172. Nearly all the exercises in this chapter have been practically discussed in previous chapters.

173. If I purchase a horse for £50 and sell it for £55 I make a profit of £5 on £50 or $\frac{5}{50}$ of the purchase money. Since $\frac{5}{50} = \frac{10}{100}$, a profit of £5 on £50 is a profit of £10 on £100, or of 10 per cent.

174. We can if we like perform the subtraction at the end of the operation, thus: if a horse cost £50, and is sold for £55, the selling price is $\frac{55}{50}$ or $\frac{110}{100}$ of the buying price: hence, as before, the profit is 10 per cent.

175. By the principle of reciprocity if I know the selling price and the profit per cent. I can find the original price; *e.g.*, what did I give for a horse which I sold for £54 at a profit of 8 per cent.

The selling price is $\frac{108}{100}$ or $\frac{54}{50}$ of the buying price; ∴ the buying price is $\frac{50}{54}$ of £54, or £50.

176. To find the rate per cent. in the case of a loss. I purchase eggs at 7s. 6d. a hundred and sell them at two for three halfpence, what per cent. do I lose?

Each egg costs me $\frac{90}{100}$d. or $\frac{9}{10}$d., and for it I receive $\frac{3}{4}$d.; $\frac{\frac{3}{4}}{\frac{9}{10}} = \frac{5}{6} = \frac{83\frac{1}{3}}{100}$; ∴ I lose $16\frac{2}{3}$ per cent.

177. In the example in 176, I could have proceeded thus:

Since each egg cost me $\frac{9}{10}$d., and for it I only received $\frac{3}{4}$d., I lost on each egg $\frac{9}{10}$d. $- \frac{3}{4}$ or $\frac{3}{20}$d. and $\frac{\frac{3}{20}}{\frac{9}{10}} = \frac{16\frac{2}{3}}{100}$; ∴ I lost $16\frac{2}{3}$ per cent.

178. To work an example from the Government Papers. Sold goods for £19 11s. 8d., and lost 6 per cent. on my outlay; what was the cost?

Since £19 11s. 8d. is $\frac{94}{100}$ or $\frac{47}{50}$ of the outlay, the outlay is $\frac{50}{47}$ of £19 11s. 8d., or £20 16s. 8d. I really worked this thus: £19 11s. 8d. is £$19\frac{7}{12}$ or £$\frac{235}{12}$ and $\frac{1}{47}$ of this is £$\frac{5}{12}$, and 50 times this is £$\frac{250}{12}$ or £20 16s. 8d.

179. Here is one more example in which the selling price is asked for. If I purchase goods for £120 15s. 6d. at what price must I sell them to lose $13\frac{1}{3}$ per cent.?

$\frac{86\frac{2}{3}}{100} = \frac{260}{300} = \frac{13}{15}$ and $\frac{13}{15}$ of £120 17s. 6d. is $\frac{13}{15}$ of £$120\frac{7}{8}$ or £104 15s. 2d. We can see at once that $\frac{13}{15}$ of £120 is £104, and $\frac{13}{15}$ of £$\frac{7}{8}$ is (91×2)d., or $\frac{91}{6}$s., or 15s. 2d.

180. EXAMPLES XVII.

In the ten following examples find the selling price to make a profit or loss of as many per cent. as are stated against each price.

1. £237 3s. 4d. to gain 5 per cent.
2. £357 7s. 6d. ,, 7½ ,,
3. £27 6s. 8d. ,, 12½ ,,
4. £105 16s. 3d. ,, 13⅓ ,,
5. £213 13s. 4d. ,, 25 ,,
6. £75 2s. 6d. to lose 26⅔ per cent.
7. £357 7s. 6d. ,, 15 ,,
8. £117 7s. 6d. ,, 17½ ,,
9. £85 10s. 7½d. ,, 3½ ,,
10. £10 8s. 4d. ,, 8 ,,

In the ten following examples find the buying price, if the gain or loss per cent. has been that placed against the several selling prices.

11. £16 9s. 11d. having gained 7 per cent.
12. £16 2s. 5d. ,, 6 ,,
13. £28 ,, 16⅔ ,,
14. £5 10s. 3d. ,, 8 ,,
15. £11 11s. 10d. ,, 7 ,,
16. £2,691 4s. 6d. having lost 10 ,,
17. £1,538 15s. 6d. ,, 10 ,,
18. £102 ,, 15 ,,
19. £80 14s. 8d. ,, 13½ ,,
20. £13 6s. 4d. ,, 6 ,,

Find the per centage which is gained or lost if articles be bought and sold at the pairs of prices in the following ten cases.

	Buying Price.	Selling Price.
21.	£6 7s. 1d.	£7 2s. 4d.
22.	£30 8s. 4d.	£31 6s. 7d.
23.	£25 8s. 4d.	£27 14s. 1d.
24.	£7 14s. 2d.	£8 3s. 5d.
25.	£15 8s. 4d.	£16 9s. 11d.
26.	£532 5s. 10d.	£521 12s. 11d.
27.	£135 3s. 4d.	£131 15s. 9d.
28.	£381 9s. 0½d.	£356 0s. 5½d.
29.	£17 1s. 8d.	£15 10s. 11d.
30.	£28 6s. 8d.	£25 4s. 4d.

31. If eggs be bought at the rate of three a penny, how many must be sold for 7d. to give a profit of 40 per cent.?

32. If £30 is a loss of 1½ per cent. on a certain amount of goods, for what were they bought?

33. By selling 10 acres of land for £4.699 8s. 3d. a man gained 5½ per cent., what was the original price of each acre?

34. If a person selling sugar for 112 × 4½d. loses 10 per cent., what did he give for it?

35. If oranges can be bought at the rate of 20 a shilling and sold at the rate of 25 for 1s. 9d., what is the gain per cent.?

36. Sugar which cost £2 10s. a cwt. is sold at a profit of 12 per cent., find the selling price per lb.?

37. From 36 frame a rule to find the selling price of sugar per lb. from the buying price per cwt., when the profit is 12 per cent.

38. At what price per lb. must rice, which costs 16s. 8d. a cwt., be sold so as to give a profit of 12 per cent.

39. If rice can be sold at a profit of 12 per cent. for 1¾d. a lb., what did it cost per cwt.?

40. At what price per oz. must a spice be sold so as to lose 4 per cent. if it cost 4s. 2d. per lb. (Av.).

41. By what fraction must I multiply the price per lb. so as to find the selling price per oz. (Av.), giving a profit of 20 per cent.

42. By what fraction must I multiply the price per ton so as to find the selling price per qr., giving a profit of 20 per cent.?

43. By what fraction must I multiply the price per ton in pounds so as to find the selling price per lb. in pence, giving a profit of 19 per cent.?

44. At what price per lb. must I sell sugar which cost me £33 6s. 8d. a ton, so as to gain 19 per cent.?

45. At what price per lb. must I sell tea which cost me £200 per ton, so as to gain a profit of 26 per cent.?

46. By what fraction must I multiply the price of land per acre expressed in pounds so as to give the number of shillings per pole at which I could let it at a profit of 20 per cent.?

47. For how many shillings per pole can I let land which costs me £50 an acre, so as to make a profit of 20 per cent.?

48. For how many farthings a grain could I sell a drug which cost me £12 a lb. (Apoth.), so as to make a profit of 50 per cent.?

49. For how many pence per oz. could I sell tea which cost me £500 a ton, so as to make a profit of 74¾ per cent.?

50. How many sweets, which weigh half an ounce each, could I sell for ½d., so as to make a profit of 124 per cent., the materials costing me £33 6s. 8d. a ton?

(To be continued.)

Christopher Columbus, by Lamartine.

TRANSLATED BY A. M. BOWER, F.R.G.S.,

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CHRISTOPHE COLOMB. PREMIÈRE PARTIE.

CHRISTOPHER COLUMBUS. FIRST PART.

CHAPTER X.

Pendant ces inutiles sollicitations
à la cour de Portugal,
l'infortuné Colomb
avait perdu sa femme,
l'amour, la consolation
et l'encouragement
de ses pensées.
Sa fortune, négligée
pour ses perspectives
de découverte,
était ruinée ; ses créanciers
s'acharnaient sur les fruits
de ses travaux,
saisissaient ses globes et
ses cartes, et menaçaient
même sa liberté.
Beaucoup d'années
avaient été perdues ainsi
dans l'attente ;
son âge mûr s'avançait,

son enfant grandissait ;
les extrémités de la misère
étaient le seul patrimoine

qu'il envisageait,
au lieu d'un monde
qu'il avait entrevu
pour lui.
Il s'évada nuitamment
de Lisbonne, à pied,
sans autre ressource
que l'hospitalité
sur sa route,
et tantôt menant
son fils Diego
par la main,
tantôt le portant
sur ses robustes épaules,
il entra en Espagne,
décidé à offrir
à Ferdinand et à Isabelle,
qui y regnaient alors,

cet empire ou ce continent

refusé par le Portugal.
C'est en poursuivant
ce long pèlerinage
vers le séjour mobile

de la cour d'Espagne,
qu'il était arrivé
à la porte du monastère
de la Rabida,
près de Palos.
Il se proposait
de se rendre d'abord
à la petite ville de Huerta,
dans l'Andalousie,
habitée par un frère
de sa femme,
de déposer son fils Diego
entre les mains
de ce beau-frère,

During these fruitless entreaties
at the Court of Portugal,
the unfortunate Columbus
had lost his wife,
the love, the consolation
and the encouragement
of his thoughts.
His fortune, neglected
for his prospects
of discovery,
was ruined ; his creditors
pounced upon the fruits
of his toils,
seized his globes and
his charts, and threatened
even his liberty.
Many years
had thus been lost
in waiting ;
his mature age was advancing,
his child was growing up ;
extreme misery
was the only patrimony (prospect)
which he saw before him,
instead of a world
which he had conceived
for himself.
He escaped by night
from Lisbon, on foot,
without any other resource
but hospitality
on his journey,
and at times leading
his son Diego
by the hand,
at other times carrying him
on his strong shoulders,
he entered (into) Spain,
resolved on offering
to Ferdinand and Isabella,
who were then reigning there,
that empire and that continent
refused by Portugal.
It was while pursuing
this long pilgrimage
towards the changeable domicile
of the Court of Spain,
that he had arrived
at the door of the monastery
of La Rabida,
near to Palos.
He intended
to betake himself at first
to the small town of Huerta
in Andalusia,
where dwelt a brother
of his wife,
to leave his son Diego
in the hands
of this brother-in-law,

et d'aller seul — and to go alone
subir les lenteurs, — to bear the delays,
les hasards, et peut-être — the chances, and perhaps
les incrédulités, — the unbelief,
à la cour d'Isabelle — at the Court of Isabella
et de Ferdinand. — and Ferdinand.
On assure — We are assured
qu'avant de se rendre — that before betaking himself
en Espagne, — into Spain,
il avait cru devoir, — he had thought it his duty,
comme Italien et comme Génois, — as an Italian and Genoese,
offrir d'abord — first to offer
sa découverte à Gênes — his discovery to Genoa,
sa patrie, et au sénat — his native place, and to the Senate
de Venise ; mais — of Venice; but (we are told)
que ces deux républiques, — that these two republics,
occupées d'ambitions — absorbed in their (schemes of) ambition
plus rapprochées — nearer home
et de rivalités plus urgentes, — and in rivalries more pressing,
avaient répondu — had replied
à ses sollicitations — to his solicitations
par des froideurs et des refus. — by a cold refusal.

CHAPTER XI.

Le prieur du monastère — The prior of the monastery
de la Rabida était plus versé — of La Rabida was more skilled
dans les sciences — in the sciences
relatives à la navigation — relating to navigation
qu'il n'appartenait — than belonged
à un homme de sa profession. — to a man of his profession.
Son monastère, — His monastery,
d'où l'on voyait la mer, — from which one saw the sea,
et voisin du petit port — and near the small port
de Palos, un des plus actifs — of Palos, one of the busiest
alors de l'Andalousie, — of Andalusia at that time,
avait mis le moine — had thrown the monk
en société habituelle — into constant intercourse
avec les navigateurs — with the navigators
et les armateurs — and the shipowners
de cette petite ville, — of this little town,
uniquement adonnée — solely devoted
à la marine. — to shipping (sea-affairs).
Ses études, — His studies,
pendant qu'il avait habité — while he had lived in
la capitale et la cour, — the capital and at the Court,
avaient été tournées — had been turned
vers les sciences naturelles — towards the natural sciences
et vers les problèmes — and to the problems
qui s'agitaient alors — which agitated at that time
dans les esprits. — their minds.
Il s'émut d'abord — He was moved at first
de pitié, et bientôt après — with pity and soon afterwards
d'enthousiasme et de conviction — with enthusiasm and conviction
dans ses entretiens — in his conversations
du jour avec Colomb, — during the day with Columbus,
pour un homme qui lui parut si supérieur à sa fortune. — for a man who seemed to him so superior to his (present) fortune.
Il vit en lui — He perceived in him
un de ces envoyés de Dieu, — one of those envoys from Heaven,
qui sont repoussés — who are driven away
du seuil des princes — from the threshold of princes
ou des cités, — or from the cities,
où ils apportent — to which they bring
dans des mains indigentes — in indigent hands
des trésors invisibles de vérités. — the invisible treasures of truth
La religion comprit le génie, — Religion understood genius,
une révélation qui veut — a revelation which demands
comme les autres ses fidèles. — like others its faithful disciples.
Il se sentit porté — He felt himself urged on
à être un de ces fidèles — to become one of the faithful
qui participent — who share
à ces révélations du génie, — in these revelations of genius,
non par la découverte, — not through discoveries
mais par la foi. — but through faith.
La Providence envoie — Providence sends
presque toujours — almost always
un de ces croyants — one of these believers
aux hommes supérieurs — to these superior mortals
pour les empêcher — to prevent them
de se décourager — from becoming discouraged
de l'incrédulité, — by the unbelief,
de la dureté ou des persécutions — by the harsh persecutions
du vulgaire. — of the mob.
Ils sont la plus sublime forme — In them is the sublimest form
de l'amitié, — of friendship,
les amis de la vérité méconnue, — (being as they are) the friends of truth unrevealed,
les confidents — full of confidence
de l'avenir impossible. — in an impossible future.
Juan Perès se sentit — Juan Peres felt himself
prédestiné par le ciel — predestined by heaven
à devenir, — to become,
du fond de sa solitude, — from the depths of his solitude,
l'introducteur de Colomb — the man to introduce Columbus
dans la faveur d'Isabelle, — to the favour of Isabella,
l'apôtre de son grand — the apostle of his great
dessein dans le monde. — design to the world.
Ce qu'il aima dans Colomb, — What he admired in Columbus
ce ne fut pas seulement — was not only
son dessein, ce fut lui même, — his scheme, but the man himself,
ce fut la beauté, le caractère, — his personal beauty, his character,
le courage, la modestie, — courageous and diffident,
la gravité l'éloquence, — his earnest eloquence,
la piété, la vertu, — his piety and purity of soul,
la douceur, la grâce, — his gentle courtesy,
la patience, l'infortune — his patience, his misfortunes
noblement portée — nobly endured
révélant dans cet étranger — which revealed in this stranger
une de ces natures marquées — one of those natures stamped
par mille perfections — by a thousand perfections
de ce sceau divin — with the divine seal
qui défend d'oublier, — which forbids our forgetting
et qui force à admirer — and which compels one to reverence
un homme unique. — a remarkable man.
Après le premier entretien, — After his first talk with him
le moine ne donna pas — the monk gave not
seulement — only
sa conviction à son hôte, — his confidence to his guest,
il lui donna son cœur: — he gave him his heart:
et chose plus rare, — and what is more unusual,
il ne le lui retira jamais. — he never withdrew it from him.
Colomb eut un ami. — Columbus had a real friend.

CHAPTER XII.

Juan Perès engagea Colomb à accepter pour quelques jours — Juan Peres induced Columbus to accept for several days
un asile, ou du moins — (a) refuge, or at least
un lieu de repos, — a resting place,

dans l'humble monastère	in the humble monastery
pour lui	for himself
et pour son enfant.	and (for) his child.
Pendant se court séjour	During this brief stay
le prieur communiqua	the prior communicated
à ses amis de la ville,	to his friends in the town,
voisins de Palos,	neighbours of Palos,
l'arrivée et les aventures	(the news of) the arrival and the adventures
de l'hôte	of the guest
dont il était visité.	by whom he was visited.
Il les pria	He begged them
de venir au convent	to come to the convent
s'entretenir avec l'étranger	(and to) hold discourse with the visitor
de ses conjectures,	concerning his theories,
de ses intentions	his aims
et de ses plans	and designs
afin d'apprécier	in order to judge
si ses théories	whether his ideas
concordaient avec	were in unison with
les idées experimentales	the notions founded on the experience
des marins de Palos.	of the sailors of Palos.
Un homme éminent,	A distinguished man,
ami du prieur,	a friend of the prior,
le médecin Fernandez	(the) doctor Fernandez,
et un pilote consommé	and a very skilful pilot
de Palos,	(in) of Palos,
Pierre de Velasco,	Pierre de Velasco,
vinrent passer	came to spend
sur 'invitation du moine	by the monk's invitation
plusieurs soirées au convent	several evenings at the convent,
écoutèrent Colomb,	listened to Columbus,
sentirent leurs yeux dessillés	felt their eyes opened
par ses entretiens,	by his communications,
entrèrent avec la chaleur	entered with the warmth
d'esprits droits et de cœurs	of upright minds and honest
simples dans ses idées,	hearts into his ideas,
formèrent	formed
le premier cénacle	the first coterie (circle)
où toute foi nouvelle	in which every fresh creed
se couve	is silently prepared(hatched)
dans la confidence	in the confidence
de quelques prosélytes,	of several proselytes,
à l'ombre de l'intimité,	under the shade of friendship,
de la solitude	(of) solitude
et du mystère.	and (of) mystery.
Ces premiers amis	These first friends
conquis à ses convictions	won over to his convictions
par Colomb	by Columbus
dans la cellule	in the cell
d'un pauvre moine,	of a poor monk
lui furent peut-être	were perhaps to him
plus chers que	of more value than
l'enthousiasme	the enthusiasm
et l'applaudissement	and the applause
de l'Espagne entière,	of entire Spain,
quand le succès	when success
eut consacré	had justified
ses prévisions.	his foresight.
Les premiers croyaient	The first believed (him)
sur la foi de ses paroles,	on the faith of his words,
les derniers ne croyaient que	the last only believed (him)
sur la foi	on the faith
de ses découvertes accomplies.	of his discoveries accomplished.

Notes.

CHAPTER IX.

Jean deux (not *le deuxième*) = John the Second. *Pour que* always governs the subjunctive mood. *Charg-e-ât.* *E* is inserted before terminations which begin with *A* and *O* in verbs ending in *GER*. *Le* politique = the politician. *La* politique = the policy, or politics. Ignorée *du* roi (see *Eve's French Grammar*, paragraph 130). Translate: *Columbus appealed to the council.* *Appel-er, jet-er*: verbs ending in *-eler* and *-eter* double the *L* and *T* before the terminations *-e, -es, -ent, -erai* (etc), *-erais*, etc. (see *Eve's French Gram.*, paragraphs, 142, 3, 4, 5, 6, 7).

Épouvanté *du* vide: *de* (by) is almost always used after passive verbs of *loving, hating*, etc.

CHAPTER X.

Beaucoup *de*, but bien *des* (*Eve's Fr. Gr.*, par. 23, obs. 2). *Beaucoup d'années avaient été perdu-e-s.* Beaucoup takes only *de* after it but *bien* takes *des* (bien des années). The past part., if the verb *être* is used with it, agrees with the subject of the auxiliary verb. If an adverb of quantity (*beaucoup, combien*, etc.) governing a genitive (*d'années*) precede the verb (*avait été*) the past participle (*perdu-e-s*) agrees with the genitive (d'années) not with its subject *beaucoup*. *Le mur* = the wall: *la mûre*, the mulberry: *mûr-e* (adj.), ripe. *Avancer* v. a. = to promote: *avancer* v. n. and *s'avancer* (to advance), are intransitive. Verbs ending in *cer* preserve the c unchanged before every termination beginning with *e* (as *e, es, ez, ent, erai, erais*). Before all other terminations c receives the *cedilla*, as: *avanç-ait.* *Décider à*: the verbs which govern *à* and *de* must be learned in the grammar. See *Eve's Fr. Gram.*, appendix III. Il *était* arrivé = he *had* arrived. Intransitive verbs are conjugated with *être* not *avoir*.

Il se proposait *de* se rendre ..... *de* déposer ..... et d'aller ..... In French prepositions must be repeated. Translate into French: *I think that I ought.*

CHAPTER XI.

Plus versé ..... *qu'*il *n'*appartenait. *Ne* is required before the verb when *plus, mieux*, etc. ..... *que* precede.

*L'*on is very often used for *on* after *et, où, si, quoi, qui, que*, and at the beginning of a sentence. Also after words ending in *i* and *e*, especially in poetry. La Providence *envoi-e*: verbs ending in *oyer* change *y* into *i* before the endings *e, es, ent, erai* and *erais*. Il ne *le lui* retira jamais: the *dative* pronoun is put before the *accusative* except *lui* and *leur*, which *datives* follow the *accusative*. Translate into French: *What I love in you is not only your courage but your modesty.*

CHAPTER XII.

Translate into French: *He was visited by his friend. By whom was he visited? The friend by whom he was visited.*

Le soir but *la* soirée = the evening. Note: de *nouveau* vin, newly tapped wine, other wine. Du vin *nouveau*, newly-made wine. De *nouveaux* livres, other books. Des livres *nouveaux*, newly-printed books.

Un *nouvel* habit, a new or another coat. Un habit *nouveau*, a coat of a new fashion. Un habit *neuf*, a coat just made, or very little worn.

(To be continued.)

—o—

The Musical Instrument (Violin) Maker of Cremona.

Scene VII.—*continued.*

Giannina.	
Oui, je veux.	Yes, I insist.
[*à part.*	[*aside.*
C'est l'unique moyen de savoir s'il se flatte	This is the only means to know if he flatters himself
Ou s'il dit vrai.	Or if he speaks the truth.
Filippo.	
Je prends, s'il vous plaît, la sonate	I take, if you please, the sonata
En 'sol,' de Cerelli?	In 'sol,' by Cerelli?
Giannina.	
Tout ce que vous voudrez.	Anything you like.
Filippo.	
[*derrière le pupitre.*	[*behind the desk*
Ecoutez bien cela.	Listen well to that.

Scène muette. Filippo exécute les premières mesures d'un thème majestueux et grave sur son violon qui est d'une sonorité merveilleuse. Le visage de Giannina, qui l'écoute attentivement, ne tarde pas à exprimer une admiration douloureuse ; puis elle laisse tomber sa tête dans ses mains et fond en larmes. Filippo s'en aperçoit enfin et s' écrie :

Silent Scene. Filippo executes the first bars of a majestic and grave theme on his violin which is marvellously sonorous. The face of Giannina, who listens to him attentively, soon expresses admiration mingled with sorrow ; then she hides her face in her hands and bursts into tears. Filippo at last notices it and exclaims :

Que vois-je? vous pleurez!
What do I see? You are weeping!

Ainsi je fais pleurer, moi qui faisais tant rire !
Thus I am the cause of weeping, I so often the cause of mirth!

N'est-ce pas que l'art est consolant et beau, Puisque ce malheureux bossu, ce Filippo Qu'ils accablaient tantôt de rires et de pierres, A pu faire germer des pleurs sous vos paupières ?
Is not art consoling and beautiful, Since this miserable hunchback, this Filippo Whom they not long since overwhelmed with jeering and stones, Has succeeded in drawing tears from your eyes ?

Oh ! non, je ne suis plus le paria d'hier, J'ai le droit de lever la tête et d'être fier.
Oh! no, no more am I the outcast of yesterday, I have the right to lift up my head and to be proud.

Je vous ai fait pleurer, mais ceci me dispense, Giannina, d'autre gloire et d'autre récompense, Et nul prix ne serait pour moi plus précieux Que les chers diamants qui tombent de vos yeux !
I have moved you to tears, what need have I, Giannina, of other glory, and of other reward, And no prize would be for me more precious Than the dear diamonds which fall from your eyes !

Giannina.

Arrêtez.....Je ne puis vous tromper d'avantage. Je comprends votre orgueil d'artiste et le partage Comme j'ai partagé naguère vos douleurs ; Mais ce n'est pas cela qui fait couler mes pleurs.
Stop.....I cannot deceive you any longer. I understand this pride of an artist and share it As I formerly have shared your griefs ; But this is not the cause of my tears.

Filippo.

Et qu'est-ce donc?
And what then is it ?

Giannina.

Je vais vous faire de la peine ; Mais vous aurez pitié de moi, j'en suis certaine, Quand je vous aurai dit, mon bon, mon vieil ami, Que j'avais un amour dans le cœur, que parmi Les rivaux, je rêvais le succès pour un autre..... Et que mon bonheur est détruit par le vôtre.
I shall cause you pain ; But you will pity me, I am sure of it, When I have told you, my kind, my old friend, That my heart was filled with a love, that from among The rivals, I dreamed of success for another..... And that my happiness is destroyed by yours.

Filippo.

Ah !
Ah !

Giannina.

C'est qu'il ne faut pas en être trop fâché, Voyons..... j'ignorais tout, vous m'aviez tout caché.
But you must not be too angry about it. You see.....I was ignorant of everything and you had hidden from me all.

Je vous croyais encore un ouvrier novice ; C'était bien naturel, après tout, que je fisse Des souhaits de bonheur pour l'homme que j'aimais. Si j'avais su la chose, ah ! je vous le promets, Je ne me serais pas sans effort décidée Entre vous deux ; j'aurais accepté cette idée Que vous pouviez avoir plus de talent que lui, Enfin, je n'aurais pas pleuré comme aujourd'hui.
I thought you an apprentice yet ; It was quite natural, after all, that I formed Wishes of success for the man I loved. If I had known how the case stood, ah ! I assure you, I should not have without an effort decided Between you two ; I should have accepted the idea That you might have more skill than he, In short, I should not have wept as I did to-day.

Filippo.

[*désignant la porte pour où est sorti Sandro.* Vous aimez? .....
[*pointing to the door through which Sandro has gone out* You love? .....

Giannina.

[*à voix basse.* Oui ! .....
[*in a low tone.* Yes ! .....

Filippo.

Sandro ! .....
Sandro ! .....

Giannina.

Voyez, je vous confie Sans hésitation le secret de ma vie..... Il nourrissait aussi l'espoir de réussir, Et c'était, j'en conviens, mon plus ardent désir ; Mais maintenant, après ce que je viens d'entendre, Je vois bien qu'à ce prix il ne doit plus prétendre, A ce prix qui servait notre amour mutuel. Perdre un si cher espoir, n'est-ce pas, c'est cruel? Oh ! mon chagrin n'a pas d'amertume ; au contraire, Car c'est mon compagnon d'enfance, c'est mon frère Qui doit avoir le prix et qui l'a mérité..... Mais c'est plus fort que moi.....Pardon..... [*elle pleure abondamment.*
See, I confide to you Without hesitation the secret of my life ..... He also nourished the hope of success, And it was too, I confess, my most ardent desire, But now, after what I have just heard, I perceive indeed that he must no longer look forward to this prize, To that prize which aided our mutual love. It is cruel to lose so dear a hope, is it not? Oh ! My grief is without bitterness ; on the contrary, For it is the companion of my childhood, it is my brother Who shall have the prize, and who has merited it... But this is stronger than I .....Pardon..... [*she weeps copiously.*

Filippo.

En vérité, Je souffre autant que vous, et je vous en supplie.....
Truly, I suffer as much as you do, and I entreat you .....

Giannina.

[*avec un effort.* Oh ! oui, c'est mal, je suis bien injuste.....j'oublie Votre infortune, à vous, et je ne songe pas Que, malade et chétif, vous n'avez ici-bas, Pauvre ami, que votre art, qui du moins vous console.
[*with an effort.* Oh ! yes, it is too bad, I am very unjust...I forget Your misfortune, and I do not consider That, ill and miserable, you have here below, Poor friend, only your art, which at least consoles you.

C'est fini. Je n'ai plus de chagrin. J'étais folle.
Enough.....I feel no more grief .....I was foolish.

C'est bien ainsi : l'amour à lui, la gloire à vous.
Mon cher Sandro sera quand même mon époux.
Et vous êtes un grand artiste que j'admire,
Et je vous aime bien et je veux vous sourire.
[*elle lui prends les mains.*
Et je ne pleure plus.....je le veux, je le dois.....
Vous voyez, je souris .....
[*éclatant en sanglots.*
Mais c'est plus fort que moi !
[*Elle sort.*

It is well so : Love for him, glory for you.
My dear Sandro will all the same be my husband.
And you are a great artist whom I admire,
And I love you well, and I will smile on you.
[*she seizes his hands.*
I weep no more.....I will have it so, I must.....
You see, I smile
[*bursting into sobs.*
But it is stronger than I !
[*Exit.*

Scène VIII.

Filippo.

[*seul, après un instant de méditation douloureuse.*
Eh bien, quoi ? Tout est dit ...C'est un autre qu'elle aime,
Et voilà d'un seul mot résolu le problème
De mon bonheur...Un autre ! Oui, ce jeune ouvrier .....
Pourquoi pas, après tout ? Vas-tu te récrier,
L'accuser d'injustice et t'indigner contre elle ?
Mais, malheureux, la chose est toute naturelle.
A son âge, un amant, comment le rêve-t-on ?
Pareil à ce jeune homme ; et toi, triste avorton,
Qui fais sur ton chemin rire la populace,
Tu ne t'es donc jamais regardé dans la glace ?
Et je n'ai rien vu, rien ! Aveugle ! Aveugle et fou !
Allons, vas te cacher, bossu, dans quelque trou !
Elle aime ce Sandro ? Qu'ils soient heureux ensemble !
Toi, va-t-en, souffre et meurs ! Oh ! quel vide ! Il me semble
Que quelque chose en moi s'est éteint pour toujours.
A quoi bon, maintenant, prendre part au concours ?
A quoi bon, maintenant, ce triomphe illusoire ?
Qu'en ferais-tu, rêveur, qui ne voulais la gloire ?
Hélas ! que pour lui plaire et t'en voir admirer,
Et qui n'a réussi qu'à la faire pleurer.
Je ne concourrai pas. Ce Sandro, dans la ville,
Est, je pense, après moi, l'homme le plus habile.
Qu'il ait le prix, afin qu'elle ne pleure plus !
[*prenant son violon.*

[*alone, after a moment of painful meditation.*
Well, what ?...It is all over ...She loves another,
And with a single word the problem is solved
Of my happiness...Another ! ...Yes, this young workman...
Why not, after all ? Wilt thou cry out,
Accuse her of injustice, and get indignant with her ?
But, wretch, the thing is quite natural.
At her age, how does one imagine a lover ?
Like this young man ; and thou, sad abortive child,
Who causest the people to laugh on thy way,
Thou hast never then looked at thyself in the looking-glass ?
And I have seen nothing ! Blind that I am ! and foolish !
Go and hide thyself, hunchback, in some hole !
She loves this Sandro ? May they be happy together !
Thou, go, suffer and die ! Oh ! what a blank ! It seems
That something in me is extinguished for ever.
What is the good now to take part in the competition ?
What would it avail now, this illusory triumph ?
What wouldst thou with it, dreamer, who did not want glory ?
Alas ! but to please her and to see thyself admired for it,
And who only succeeded in making her weep.
I shall not compete. This Sandro, in the town,
Is, after me, I believe, the most clever.
Let him have the prize, that her tears may cease to flow !
[*taking up his violin.*

Et toi pour qui j'ai fait tant d'efforts superflus,
Inutile travail qu'à présent je méprise,
Ainsi que mon espoir, il faut que je te brise.
[*s'arrêtant.*
Mais quelle idée !...Oh ! Dieu ! Comme mon cœur est pris !
Si quelque autre ouvrier allait avoir le prix ?
S'il l'épousait ? ..... C'est trop l'aimer ! C'est ridicule !
Car ces deux instruments sont tout pareils ; je puis
Renoncer à mon œuvre en les changeant d'étuis.
Ce Sandro n'a pas l'âme assez musicienne
Pour distinguer d'abord mon œuvre de la sienne,
Lorsque l'on essaîra les instruments là-bas.....
Je lui dirai plus tard...On ne rouvrira pas
Ces boîtes ; on les portent au jury tout à l'heure...
Tant pis ! Je ne veux plus que la pauvre enfant pleure,
Et toi, mon violon, tu ne dois plus périr
Puisque tu peux encor l'empêcher de souffrir !
Courage ! Rendons-lui ce suprême service.
[*Il ouvre les deux étuis, met le violon de Sandro dans l'étui rouge, puis au moment de déposer le sien dans l'étui noir :*
C'est pourtant un cruel et rude sacrifice !
Je n'aurais cru jamais—ô faibles cœurs humains !—
Qu'on pût tenir autant au travail de ses mains,
Et que l'âme de feu d'un artiste eût en elle
Ce foyer de tendresse émue et paternelle.
Je t'aimais bien, ô cher ouvrage que je fis !
Adieu donc pour toujours, mon chef-d'œuvre, mon fils !
Je puis me pardonner ma faiblesse dernière,
Car dans ce coffre étroit et noir comme une bière,
Je crois, en te posant, tant j'ai le cœur en deuil,
Que c'est mon enfant mort que je couche au cercueil !
[*il referme brusquement l'étui ; puis d'une voix sourde :*
C'est fait !

And you for whom I have made so many efforts in vain,
Useless toil which I now scorn,
As well as my hope, I must break you.
[*stopping short.*
But what an idea !...Oh ! Good heavens ! How my heart is tortured !
If any other workman were to have the prize ?
If he married her ?.....This is loving her too much ! This is laughable !
For these two instruments are perfectly alike ; I might
Give up my work by changing the two cases.
This Sandro's heart is not musical enough
To distinguish at once my work from his own,
When they will try the instruments yonder.....
I shall tell him later on..... They are not going to open again
These cases ; they will carry them presently before the jury...
So much the worse ! I do not want the poor child to weep any longer,
And you, my violin, you are not to perish
Since you may yet prevent her sufferings !
Courage ! Let us render her this supreme service.
[*He opens the two cases, puts Sandro's violin in the red case, then at the moment of putting his own in the black case :*
Yet it is a cruel and rough sacrifice !
I should never have believed—oh weak human hearts !—
That one could care so much for the work of one's own hands,
And the fiery soul of an artist should have in itself
This warmth of loving and paternal tenderness.
I loved you well, oh dear work of my hands !
Good-bye then for ever, my master-piece, my son !
I can pardon my last weakness,
For in this case, narrow and black like a bier,
I believe, whilst placing you into it, so much is my heart wrapt in sorrow,
That it is my child that I put into the coffin.
[*he shuts the case hurriedly, then with hollow voice :*
It is done !

Translate into French :—

Among the Lords who surrounded Henry the Second there was a young cavalier named Thomas à Becket. The king preferred him to his other courtiers because he was braver, more amiable, more merry, more magnificent in his dress and his retinue than all his companions. No English or Norman Baron had so large a number of servants elegantly equipped, so large a number of horses, dogs, and falcons of the best breed. Never did Becket allow anyone to visit him without carrying away with him some present. Henry the Second wished to keep him always at his side ; in war, in hunting, in his games as in his travels no one better than Becket found means of amusing him, and the friendship which the king showed him appeared likely to last as long as their lives.

Notes to 'Le Luthier de Crémone.'

SCENE II.

Lui prenant *les* mains : In speaking of parts of the body the *name* of the person whether *noun* or *pronoun* is put in the *dative* and the article used with the parts of the body (*Eve*, 145, 145a).

Le maître garde-t-il? When the subject of an interrogative sentence is a noun, the order is (1) subject, (2) verb, (3) pronoun, repeating the subject (*Eve*, 11 to the end).

J'en mourrai (*Eve*, 140). Que je vous *oublirai* (a contraction allowed in poetry, for *oubli-erai*). *Fussé*-je (the pluperfect subj. is often used in conditional sentences and the first person accented as above for euphony (*Eve*, 135, Notes 4, 5, 6).

Translate : *This event decided my fate. I am satisfied with it. Aigu ; fem* = *aiguë.* Pourquoi *douter?* (the *infinitive* is used *interrogatively*). *Chez* is from the *Latin casa* (*house*) and means *at-the-house-of*. Je *veux* que (takes *subj.*). Translate : *I am afraid, ashamed, thirsty, hungry*, etc. *Que* ma patronne.... *protège* (the *subj.* is used to express a wish : *Eve*, 181).

L'harmonieuse lutte (the noun is here placed after the adjective for the sake of the rhyme). Translate: *How sad you are.*

Et l'on (*l'* is euphonic). Je devrais *bien* (= really).

Protège. All words in *ege* hitherto accented *ége* are henceforth, says the Académie Française to be accented *ège*.

SCENE III.

M'y voi-ci, lit. 'behold me here': *voi* is from *voir, to see*, Un gâte-sauce, *plural, des gâte-sauce :* when the first part of the compound is a verb the plur. is the same as the sing. (*Eve*, 52, 53.) Rien-qui-vaille is a compound noun invariable in the plural. *Aux yeux éteints* (descriptive dative). *Sans ma fuite*, the protasis, *if I had not fled*, the *apodosis* to which is *On m'eût assassiné. Remerct-* or *remercie*-ment. Philomèle, the nightingale, from Philomela, daughter of Pandion, king of Athens, who was changed into a nightingale and her sister changed into a swallow. Aiguière is pronounced aig-ière. À = *in the act of*, in Ils sont toujours *à* se quereller.

Patte brisée (*patte* is used of soft-footed animals and also of birds, reptiles, and insects). *Se mettre à* = to set oneself to = begin.

SCENE IV.

Plus *de vingt* (*de* = *than* before numerals). Je viens de dîner = I come from dining = I have just dined. *Quand* on aura fait, etc., et *que* (= quand): *que* is used to avoid repeating *quand* (*Eve*, 254).

SCENES V. & VI.

Il *l'est* (*le* replaces the adj. *prêt*). *Ton* succès *à toi* (*à toi* gives emphasis to *ton*). *C'est* démence (*que*) *de* croire, etc. = (the fact) of believing, etc., is madness : *ce* is the anticipative subject, in apposition to the real subject *de croire*. C'est démence de croire qu'un homme *trouve* ; this expression is equal to *croyez-vous* qu'un homme *puisse* trouver : hence the subjunctive used after *croire interrogative.*

Sans que... s'en *irrite* (*sans que* takes *subj.*) *Sur qui* should be *sur laquelle* but the poet personifies the violin, hence *qui* may be used. *Va jaillir*, should be *vont* jaillir to agree with the two nominative cases *scherzo* and *lento*. *Scherzo* is pronounced *sker-tso*. (Soit) que tu fasses = *be it* that, etc.

SCENE VII.

Si Sandro peut *encor ;* note the omission of the *e* (which would make one syllable) in *encore*. J'ai appris... que vous allez, etc. *Qui, dit-on, doit avoir le prix, certainement* has no cæsura. Mon œuvre *que voi-ci*, lit., my work *which behold-here, i.e.*, which you see here in my hands. La boîte *en* vieux sapin (*en* denotes the *material*). Et sonore *à* (= enough to). *Jouir d'*une chose = to enjoy anything ; *jouer de* = to play on. *Lorsque* l'herbe frissonne et (*lors*) *que* (*que* replaces lorsque) et (lors) que des buissons, etc.

Où mon âme se noie (où = dans lesquels). *C'est* si beau *que* cela ! = cela est si beau : *ce* and *que* are pleonastic. Jouez *donc* un air ! *C* in *donc* is pronounced only at the beginning of sentences or before a vowel as here. Mon *vieil* ami (*vieux* is also used before vowels).

Je ne puis : peux is used in familiar conversation and style, *puis* in the higher style and in poetry. In the higher style it is better to use only *ne* with *puis, cesser, oser*, and in *si ce n'était*, etc.

Davantage is not followed by *que, than*, but used absolutely.

C'était bien naturel que je fisse (*subj.* after the *impersonal* expression *c'était naturel*). Perdre un si cher espoir, *c'est* cruel (*ce* is pleonastic). Je le veux, je le *dois* [s]. In early French the 1st person sing. had no *s* which was added *only* in the 14th century. *Pleurs*, m.pl. = '*lamentation*,' is never used now in the plural ; *larme* supplies its place. *Je vous le promets*, for the less familiar, *je vous assure*. *Votre* infortune *à vous* (*à vous* gives emphasis to *votre*) *souris* (I smile); *un* souris, a smile ; *une* souris, a mouse.

(To be continued.)

—o—

Model Answers to the Matriculation Questions.

JUNE, 1887.

Geometry.

1. If one side of a triangle be produced, prove that the exterior angle is greater than either of the interior and opposite angles.

Proposition 16. Book I.

2. If two triangles have two angles of the one respectively equal to two angles of the other, and the sides adjacent to the equal angles in each equal, show that the triangles are equal in all respects.

Proposition 26. Book I.

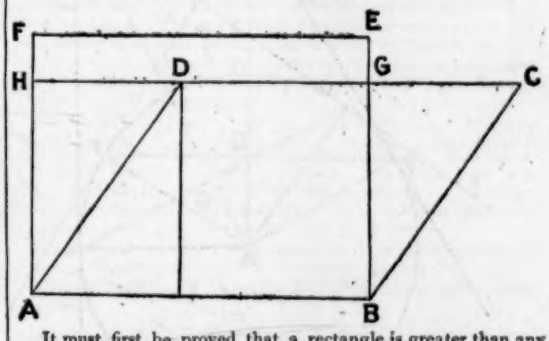
3. Prove that equal triangles on the same base and on the same side of it are between the same parallels.

Proposition 39. Book I.

4. If a straight line be divided into two equal parts and also into two unequal parts, show that the rectangle contained by the unequal parts, together with the square on the line between the points of section, is equal to the square on half the line.

Proposition 5. Book II.

5. Prove that of all parallelograms with equal perimeter the one which has the largest area is a square.

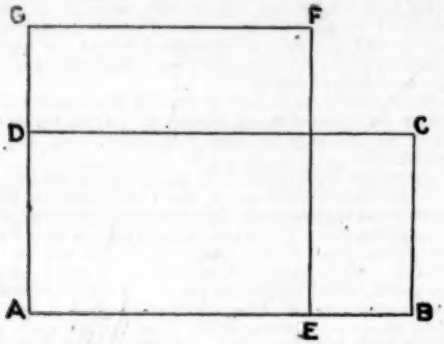


It must first be proved that a rectangle is greater than any parallelogram on the same base with the same perimeter.

Let ABCD be a parallelogram, and ABEF a rectangle on the same base AB, and having the same perimeter ;

Then AF = AD, and therefore perpendicular from D on AB is less than AF (I. 19).

Let CD produced cut BE at G, and AF at H;
Then parallelogram ABCD = parallelogram ABGH (I. 35), and is, therefore, less than rectangle having the same perimeter.



It must now be proved that a square is greater than any rectangle having the same perimeter.
Let ABCD be a rectangle, AB being longer than AD.
Let AEFG be a square having the same perimeter, E being on AB, and G on AD produced.
Since the perimeters are equal,

EB = GD,

and BC is less than GF;
Therefore rectangle EC is less than rectangle DF;
Wherefore rectangle AC is less than the square AF.

Q. E. D.

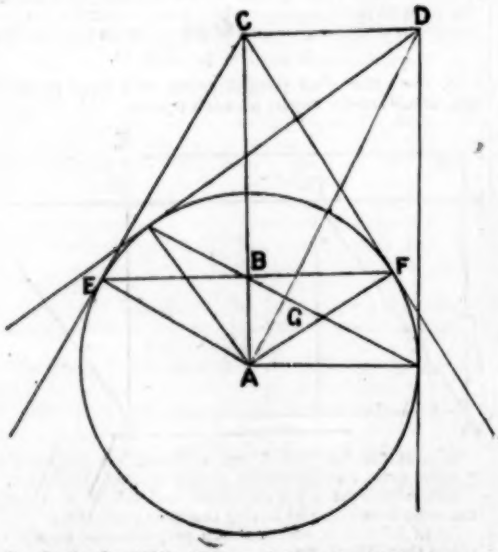
6. If from a certain point inside a circle more than two equal straight lines can be drawn to the circumference, prove that this point is the centre of the circle.

Proposition 9. Book III.

7. Prove that the opposite angles of any quadrilateral figure inscribed in a circle are together equal to two right angles.

Proposition 22. Book III.

8. A is the centre of a circle, B a point inside it. Through B a chord is drawn perpendicular to BA. Prove that if the tangents at its extremities intersect at C, then the rectangle contained by AB and AC is equal to the square on the radius of the circle.
Show further that if the tangents at the extremities of any other chord through B intersect at D, then DC is perpendicular to AC.



Proof.—Angles AEC, AFC are right angles (III. 18);
Therefore angles EAF, ECF are together equal to two right angles (I. 32);
Wherefore a circle can be described passing through the four points A, E, C, F (Converse of III. 22).
Because the straight lines AC, EF cut one another within a circle,
Rectangle AB . BC = rectangle EB . BF (III. 35),
= square on BE (III. 3);
To each of these add the square on AB;
Then rectangle AB . BC + square on AB = square on BE + square on AB (Ax. 2);
But rectangle AB . BC + square on AB = rectangle AB . AC (II. 3);
And square on BE + square on AB = square on AE (I. 47);
Therefore rectangle AB . AC = square on AE
= square on radius of the circle.

Q. E. D.

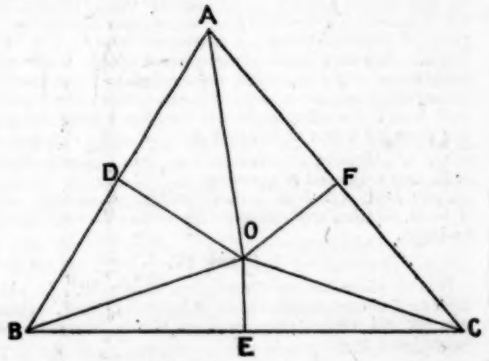
Similarly it can be proved that rectangle AG . AD = square on radius of the circle;
Therefore rectangle AG . AD = rectangle AB . AC (Ax. 1);
Wherefore a circle can be described passing through the four points C, B, G, D (Converse of III. 36, Cor.).
Because CBGD is a quadrilateral inscribed in a circle,
Angles BGD, BCD are together equal to two right angles (III. 22);
But angle BGD is a right angle;
Therefore angle BCD is a right angle;
Wherefore DC is perpendicular to AC.

Q. E. D.

9. Show how to circumscribe about a given circle a triangle equiangular to a given triangle.

Proposition 3. Book IV.

10. If the three sides of a triangle be bisected, and if through each point of bisection a straight line be drawn perpendicular to the side on which it lies, show that these three straight lines meet at a point equidistant from the angular points of the triangle.



Let ABC be a triangle, and let the sides be bisected at D, E, F.
At D and E erect perpendiculars (I. 11);
These perpendiculars will meet one another,
For if they do not they are parallel;
Therefore AB and AC, which are at right angles to them, are parallel; which is absurd.
Let them meet at O, and join OF.
Then OF shall be at right angles to AC.
Proof.—Join OA, OB, OC.
In the triangles AOD, BOD, AD = BD (Con.);
DO is common, and angle ADO = angle BDO (Ax. 11);
Therefore base AO = base BO (I. 4).
Similarly it can be proved that AO = CO;
Therefore AO, BO, CO are equal to one another (Ax. 1).
Again, in the triangles AFO, CFO, AF = CF (Con.),
FO is common, and base AO = base CO;
Therefore angle AFO = angle CFO (I. 8);
Wherefore OF is at right angles to AC, that is the three perpendiculars DO, EO, FO meet at the point O.

Q. E. D.

Chemistry.

1. Explain what is meant by the terms, 'Combining proportion by Weight and by volume.' Give examples.

The same substance is invariably composed of the same elements united in the same proportion.

When an element unites with another in different proportions the higher proportions are invariably multiples of the lowest.

If two bodies A and B separately combine with a third body C the proportions of A and B which unite with C are measures or multiples of the proportions in which A and B combine together.

The combining proportion of an element by weight is the least proportion by weight in which it enters into compounds with other elements.

Its combining proportion by volume is the least proportion by volume in which it enters into compounds with other elements, the volumes being measured when the elements are under *like conditions*.

Examples.—The combining proportion of nitrogen by weight is 14, of oxygen 16, of hydrogen 1.

parts by weight of				combine to form	
14	nitrogen and	3	of hydrogen ...	... ammonia	NH_3
28	,,	16	of oxygen ...	nitrous oxide	N_2O
28	,,	32	,, ...	nitric oxide	N_2O_2
28	,,	48	,,	nitrous anhydride	N_2O_3
28	,,	64	,, ...	nitric peroxide	N_2O_4
28	,,	80	,, ...	nitric anhydride	N_2O_5
2	hydrogen and	16	,, ...	water	H_2O
2	,,	32	,, ...	hydroxyl	H_2O_2

1 part by weight of hydrogen, 14 of nitrogen, and 48 of oxygen, combine to form nitric acid HNO_3.

1 part by weight of hydrogen, 14 of nitrogen, and 32 of oxygen, combine to form nitrous acid HNO_2.

If in each of the above we divide the nitrogen proportion by 14 and the oxygen by 16 we get the combining proportions by volume, which are equal for the three elements.

Thus—

2 volumes of hydrogen and 1 of oxygen give water H_2O
3 ,, ,, 1 of nitrogen give ammonia H_3N
1 of hydrogen, 1 of nitrogen, and 2 of oxygen, give nitrous acid HNO_2.

2. Give some account of the nature and composition of ordinary fuel. State fully the chemical changes which occur in the combustion of coal.

'Coal is essentially carbon combined with hydrogen, oxygen, and nitrogen, and more or less mineral substance. It has been produced from vegetable matter by a complicated series of chemical changes, attended with the elimination of water, carburetted hydrogen and carbon dioxide. Its vegetable origin is established by its ligneous structure, and by its association with the fossil remains of the flora from which it has been derived. All coal contains inorganic matter or ash, varying from 1 to 30 per cent. The ash usually consists of silicates of alumina and iron.' (Thorpe.)

When coal burns in air 'its hydrogen at once unites with oxygen to form steam. Its carbon unites with oxygen to form carbon dioxide. This gas, passing over the red-hot coal of the higher parts of the fire, is reduced to carbon monoxide. The carbon oxide reaching oxygen again in the highest parts of the fire forms carbon dioxide. These changes can be shown in symbols, thus—

$$C + O_2 = CO_2$$
$$12 + 32 = 44$$
$$CO_2 + C = 2CO$$
$$44 + 12 = 56$$
$$2CO + O_2 = 2CO_2$$
$$56 + 32 = 88.'$$

(*Dr. Aveling's* 'Chemistry of the Non-metallics.')

3. Calculate the weight of pure marble that must be treated with hydrochloric acid in order to afford 100 cubic centimetres of carbon dioxide measured at 0°C. and 760 mm. (Ca = 40; C = 12.)

The equation for this reaction is

$$Ca\,CO_3 + 2\,H\,Cl = Ca\,Cl_2 + H_2O + CO_2$$
$$100 + 73 \qquad 111 + 18 + 44$$
2 vols. (*Aveling.*)

Thus 100 grams of marble yield 44 grams of carbon dioxide, which 44 grams of gas would fill 22·4 litres at 0°C and 760 mm.

Thus 100 grams of marble give 22,400 c.c. of gas,
and ∴ $\frac{100}{111}$,, ,, 100 ,,
$\frac{100}{111} = \frac{44}{111} = .446$.

Thus we must take .446 gram of marble.

4. Give an account of the mode of preparation and properties of nitrous oxide.

Nitrous oxide is prepared from ammonium nitrate, thus—Neutralize ammonia with nitric acid and evaporate the liquid compound until the solid salt ammonium nitrate is deposited. Put this in a flask whose delivery tube passes into an empty bottle standing in a pan of cold water. From the empty bottle a tube passes to a gas jar. Heat the flask. The salt melts, seems to boil, breaks up into steam which is condensed in the empty bottle, and nitrous oxide which is caught in the gas jar. The gas must be caught over hot water, not cold, as it is soluble in water.

$$NH_3 + HNO_3 = NH_4NO_3 = 2H_2O + N_2O$$
$$17 + 63 = 80 = 36 + 44$$
Ammonia. Nitric acid. Amm. nitrate. Water. Nitrous oxide.

The symbol for this gas is N_2O. Molecular wt. 44. Density 22.

It is liquefied at a pressure of 30 atmospheres or a temperature of − 80°. It has a sweetish taste and smell. It is tolerably soluble in water (100 c.c. of water take up 130 c.c.) It supports combustion, but does not burn in air. In supporting combustion it is broken up into nitrogen and oxygen, which latter gas unites with the burning substance. It may be breathed without destruction of life. In small quantities it acts as a stimulant, especially to the muscular system, and hence is called 'laughing gas.' If breathed pure, it acts as an anæsthetic, and is used in dentistry. (*Aveling.*)

5. What volume of oxygen is required for the complete combustion of one volume of each of the following gases:—Hydrogen, carbon monoxide, ammonia, and marsh gas.

Hydrogen.—$2H_2 + O_2 = 2H_2O$
4 vols. + 2 vols. = 4 vols.

Thus, to burn a volume of hydrogen, we must have half a volume of oxygen.

Carbon monoxide.—$2CO + O_2 = 2CO_2$
4 vols. 2 vols. 4 vols.

Again we want half the volume of oxygen.

Ammonia.—$4NH_3 + 3O_2 = 2N_2 + 6H_2O$
8 vols. 6 vols. 4 vols. 12 vols.

We must then take ¾ as much oxygen as ammonia by volume.

Marsh gas.—$CH_4 + 2O_2 = CO_2 + 2H_2O$
2 vols. 4 vols. 2 vols. 4 vols.

We need 2 volumes of oxygen to one of marsh gas.

6. How is phosphuretted hydrogen prepared? Describe its chief properties. What is formed when it burns in the air? In what respects does it resemble ammonia?

Phosphuretted hydrogen is made from barium hydrate and phosphorus, by heating them in water in a flask. The air in the flask should first be driven out by carbon dioxide, for fear of an explosion. The gas is carried off by a tube, and collected over water in a pneumatic trough, or if left to bubble up into the air it catches fire and forms steam and phosphoric anhydride, the white fumes of which latter rise in rings through the air. The equation of the preparation is—

$$3Ba\,H_2O_2 + 6H_2O + 8P = 3Ba_2(PH_2O_2) + 2PH_3$$
Barium hydrate. Water. Phosphorus. Barium hypophosphite. Phosphuretted hydrogen.

It is a gas, not very hard to liquefy. The symbol for it is PH_3. Its molecular weight is 34, and density 17. Colourless. Smells like bad fish. Little soluble. It is not inflammable of itself, only when some of the hydride PH_3 is present.

When exposed to light for a long time P_2H is deposited as a yellow solid on the sides of the containing vessel.

When it burns in air, there are formed water and phosphoric anhydride.

$$2PH_3 + 4O_2 = P_2O_5 + 3H_2O.$$

Phosphuretted hydrogen is like ammonia in composition, the nitrogen of the ammonia being replaced by phosphorus. It has, however, no alkaline reaction. It combines with hydrobromic and hydriodic acids to form phosphonium bromide and phosphonium iodide (PH_4Br and PH_4I), just as ammonium bromide and iodide (NH_4Br and NH_4I) are formed from the combination of ammonia with those acids.

Natural Philosophy.

[N.B.—Only EIGHT questions to be answered, of which at least TWO must be selected from Section A.]

A.

1. A picture is hung by a string fastened at two corners of its frame, and passing over a smooth nail. What are the forces producing equilibrium, and how will the pull on the string vary as it is made longer or shorter?

Let ABCD be the picture, and ANB the string passing over the smooth nail N. The whole is supposed at rest in a vertical plane.

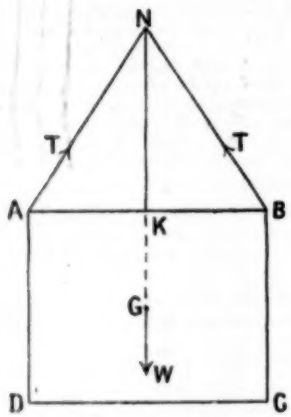
The forces keeping the picture in equilibrium are—

(1) The tension in the string NA, acting at A along AN.

(2) The tension in the string NB, acting at B along BN.

(3) The weight W of the picture acting vertically downwards through its centre of gravity, which we may call G.

Also, since the nail is smooth, the tension in the string is the same throughout, and therefore the forces (1) and (2) are equal. Call each of them T.



Thus the equilibrium of the picture is produced by three forces.

It follows that the lines of action of these forces meet in a point, since they cannot be parallel.

Thus G must be vertically beneath N, and since the forces in BN and AN are equal GN must bisect the angle ANB.

Hence the picture hangs symmetrically about the vertical through N which therefore bisects AB at right angles, say in K.

It follows then from the parallelogram of forces (see next question) since the resultant of T in AN and T in BN is W vertically upwards that $W : T :: 2NK : NB$.

Also by Euclid I., 47 $NK^2 + KB^2 = NB^2$

and therefore $\left(\frac{NK}{NB}\right)^2 = 1 - \left(\frac{KB}{NB}\right)^2$

KB is constant and NB is half the length of the string, hence as the string is made longer $\frac{NK}{NB}$ becomes greater, and $\therefore \frac{W}{T}$ becomes greater, and T grows less.

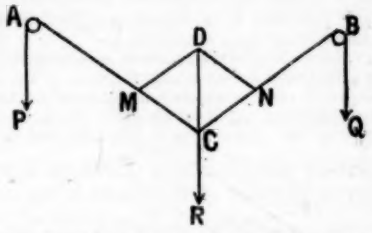
Thus as the string is made longer or shorter, the pull in it becomes less or greater.

2. State the proposition known as the Parallelogram of Forces, and describe an experiment to verify it. The sides BC, CA, AB of a triangle are bisected at D, E, and F respectively; find the resultant of forces represented by DA, EB and FC.

If two forces be represented in magnitudes, lines of action, and senses by two right lines OA and OB, their resultant is represented in magnitude, line of action, and sense by the diagonal OC of the parallelogram OACB, determined by these lines.

To verify this let us take two small smooth pulleys A and B. Let us hang a fine string over them and to the ends of this string tie two weights P and Q.

At some point C in the string between A and B hang a weight R, not greater than the sum of P and Q, nor less than their difference, and let the system come to rest.



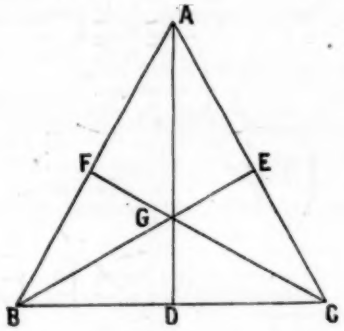
Now measure lengths CM, CN, along CA and CB from C, having the same ratio as the weights P and Q, and complete the parallelogram CMDN.

It will then be found that CD is vertical and has the same ratio to CM or CN that the weight R has to P or Q.

Hence two forces represented in magnitudes, lines of action, and senses by CM, CN have a resultant represented in magnitude, line of action, and sense by CD.

The proposition can then be verified by help of this apparatus, and that, too, for component forces in any ratio, since we may choose what weights we like for P and Q.

In practice we should have to allow for some friction at A and B, and for the stiffness and weight of the string, in order to get a perfect verification.



Rider.—The lines DA, BE, CF meet in a point G which trisects each of them.

Thus we may take as our forces $\frac{2}{3}$ GA, $\frac{2}{3}$ GB, $\frac{2}{3}$ GC.

Now since E is the middle point of AC it follows that E is the middle point of the diagonal of the parallelogram of which GA, GC, are adjacent sides, and therefore the resultant of two forces $\frac{2}{3}$ GA, $\frac{2}{3}$ GC acting along GA and GC is 3GE acting along GE.

Also GE is $\frac{1}{3}$ BG, and thus the three forces are replaced by two equal and opposite forces in GB.

Hence the resultant is zero.

3. Define stable, unstable, and neutral equilibrium, and give examples of each.

The equilibrium of a system at rest is said to be stable, if on its being slightly disturbed, the forces acting on it in its new position tend to drive it back to its old position.

If, on the other hand, they tend to drive it still further away from the old position, the equilibrium is said to be unstable.

If the forces acting on the system in its new position are again in equilibrium, the equilibrium is said to be neutral.

Take a heavy particle resting on a smooth curve in a vertical plane.

It must be at a point where the tangent is horizontal, in order to be in equilibrium at all.

If the curve rises on each side, then when the particle is slightly displaced its weight will pull it back, and the equilibrium will be stable. (Fig. 1.)

If the curve falls on each side, then when the particle is slightly displaced its weight will pull it further away, and the equilibrium will be unstable. (Fig. 2.)

If we have a horizontal straight line instead of the curve, then the particle will rest at an adjacent point just as well as where it is, and the equilibrium is neutral. (Fig. 3).

Fig. 1.

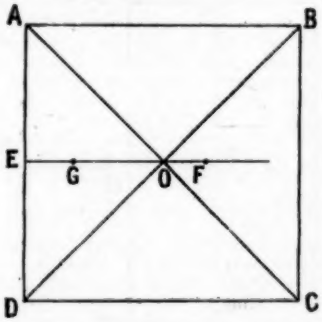
Fig. 2.

Fig. 3.

4. Show how to find the centre of gravity of a uniform triangular lamina. One of the four parts into which a square is divided by its diagonals is removed ; find the centre of gravity of the remainder.

'Let ABC be any triangular lamina of uniform thickness and density, and let it be divided by an indefinitely great number of lines parallel to the base BC into an indefinitely great number of strips. Then the centre of mass of each strip is its middle point, and the middle points of all the strips lie on the line joining A to the middle point of BC. Hence the centre of mass of the lamina lies on this line. Similarly, the centre of mass lies on the line joining B to the middle point of CA. It is, therefore, the intersection of the bisectors of the sides drawn from the opposite angles.'—(Minchin).

Let ABCD be the square, AOC, BOD the diagonals, and suppose the piece AOD taken away.



Let E be the middle point of AD. Draw EO, and produce it to F, so that $OF = \frac{3}{5}$ EO.

Then shall OF be the C. G. of the figure ABCDOA.

For take G in OE such that OG = 2GE.

Then G is the C. G. of AOD.

Also the area taken away is $\frac{1}{3}$ of that left.

Hence since O is the C. G. of the whole area, the C. G. of what is left lies on GO produced, and at a distance from O that is $\frac{1}{2}$ of OG. But $OG = \frac{2}{3}$ OE = 3OF ;

Hence F, being on GO produced, is the C. G. of the area ABCDOA.

5. Explain the action of the screw as a mechanical power. The arm of a screw jack is one yard long, and the screw has two threads to the inch. What force must be applied to the arm to raise a weight of one ton?

The screw consists of a right circular cylinder, on the outside surface of which there is a smooth uniform projecting thread in the form of a helix. The helix is a curve traced on the circumference of a cylinder in the following way : Take a sheet of paper, on which are drawn two indefinite straight lines, AB and AC, and let the paper be wound round the cylinder in such a way that the line AB coincides with the circumference of the base ; then the other line, AC, will appear on the cylinder as a spiral curve, which is called the helix.

Let p and q be two points on the indefinite line AC, and draw pn perpendicular to AB and qn parallel to it. Then pq becomes a part of the arc of the helix, and qn a part of a section of the cylinder perpendicular to its axis, while pn is still a straight line coinciding with a generator of the cylinder.

The thread works in a block, on the inner surface of which is cut a groove which is the exact counterpart of the thread. This block is called the nut. If, then, the screw moves in the nut until the point p of the thread reaches the point q of the nut, the axis must move in its own direction through a space pn.

Suppose the distance between two parts of the thread, measured along a generator (*i.e.*, a straight line parallel to the axis of the cylinder), to be b, b is called the pitch of the screw.

The screw is supposed to drive a resistance, Q, applied in the direction of its axis, and the moving force, P, is supposed applied in a plane perpendicular to the axis, at the end of an arm, whose length, measured from the axis, is a.

Suppose, now, that the screw turns round completely once. Then the point of application of P moves a distance $2\pi a$ in the direction of P, while that of Q moves a distance b in opposition to Q.

Thus the work done by P is $2\pi a$.P, and the work done against Q is Qb, and we have therefore

$$P.\,2\pi a = Qb$$

$$\text{or } \frac{P}{Q} = \frac{b}{2\pi a}$$

Rider.—Take one inch as unit of length, and the weight of a ton as unit of force.

We have then $a = 36$, $b = \frac{1}{2}$, $Q = 1$.

$$\text{Hence } P = \frac{\frac{1}{2}}{2\pi \times 36} = \frac{7}{22 \times 144} = \frac{7}{3168}$$

Thus the needful force is the weight of $\frac{7}{3168}$ ton, *i.e.*, the weight of about 4 lbs. 15 ozs.

6. A stone is projected up a smooth inclined plane with a velocity which will just carry it to the top. How far relatively would a stone ascend a plane of the same length but twice the height, if projected with half the velocity?

Let h be the height of the first inclined plane in feet. Then the velocity of the stone in the first case is $\sqrt{2gh}$ feet per second. Hence the velocity in the second case is $\sqrt{2g\,\frac{h}{4}}$ which will just carry the stone to a height $\frac{h}{4}$ *i.e.*, $\frac{1}{8}$ of the height of the second plane.

Thus the stone goes up $\frac{1}{8}$ of the height, and therefore of the length, of the second plane.

7. A mass of 10 lbs. falls 100 feet, and is then brought to rest by penetrating one foot into sand. Find the average pressure on the sand.

Let the average pressure on the sand be the weight of P lbs. Then the work done against this pressure is $Pg \times 1$ units of work, since we have a force Pg acting through a foot.

Also the body falls 101 feet under the action of gravity, which in this case means a force $10g$.

Thus the work done by gravity is $10g \times 101$ units.

Hence the whole work done on the body is $1010g - Pg$.

This, then, is the increase of its kinetic energy.

But the mass starts from rest, and therefore its kinetic energy is 0 at first. It also comes to rest in the end, and its kinetic energy is again 0.

Hence $1010g - Pg = 0$.

$$P = 1010.$$

Thus the average pressure on the sand is equal to the weight of 1010 lbs.

8. Explain what is meant by the statement that the specific gravity of mercury is 13·596. The lower ends of two vertical tubes, whose cross sections are 1 and ·1 square inches respectively, are connected by a tube. The tubes contain mercury. How much water must be poured into the larger tube to raise the level of the mercury in the smaller by one inch?

In saying that the specific gravity of mercury is 13·596 we mean that if we have equal volumes of water at 4° C, and of the mercury in question, the weights of the two will be in the ratio 1 : 13·596.

Rider.—The pressure at any fixed point in the lower part of either tube is increased by that due to an inch of mercury, which is the same as that due to 13·596 inches of water.

The level of the mercury in the larger tube is lowered by ·1 of an inch.

Hence, if x be the depth of water in the larger tube, in inches, the increase of pressure aforesaid is the pressure due to x inches of water less that due to $\frac{1}{10}$ inch of mercury.

Hence $x - 1{\cdot}3596 = 13{\cdot}596$

$x = 14{\cdot}9556$.

Thus, since the section of the larger tube is 1 square inch, we must pour in 14·9556 cubic inches of water.

9. A glass tapering tube is 10 inches long, 1 inch in diameter at one end, $\frac{1}{2}$ inch at the other. The tube is held vertical and filled with water, a thin plate (the weight of which may be neglected) being pressed against the lower end to prevent the water from escaping. Compare the forces with which the plate must be held in its place, according as the larger end of the tube is up or down.

Since the weight of the plate may be neglected, the force with which it must be held is equal to the fluid pressure on it.

This fluid pressure is equal to the weight of a cylinder of water whose base is the area pressed, and height the depth of the water.

Turning the tube upside down makes no difference to the specific gravity of the water or to its depth, and thus the pressures in the two cases are as the areas pressed, which are as the squares of their diameters, *i.e.* as 1 : 4.

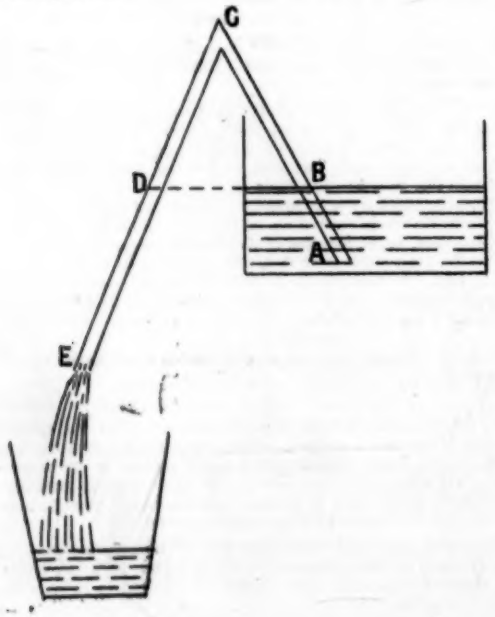
Thus, when the larger end is down, we need 4 times the force that would keep the plate up with the smaller end of the tube down.

10. Describe a siphon and explain its action, showing clearly why it is necessary that the end out of which the liquid flows should be below the level of the liquid in the vessel from which it is being drawn.

A siphon in its simplest shape consists of a bent tube. In order to draw liquid out of a vessel by it, we first fill the tube with the liquid and stop both ends. We then put one end into the liquid in the vessel, and the other over the vessel that is to catch the liquid on flowing out and unstop the ends, taking care that the outside end of the tube is below the level of the surface of the liquid in the vessel.

The liquid then flows out of the vessel through the tube.

Let ABCDE be the siphon, A being the end in the liquid, BD the level of the surface, C the highest point of the tube, and E the open end.



Suppose A unstopped and E stopped, and the liquid at rest.

The pressure throughout the liquid will be the same at the same height, and will increase with the depth. Hence the pressure at E is greater than that at D or B, *i.e.*, at the surface in the vessel.

But this pressure is equal to that of the outside air, and therefore practically to the pressure outside at E.

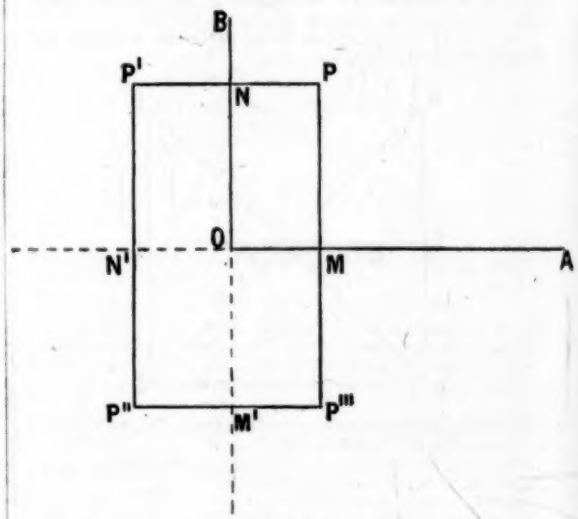
Thus the pressure at E is greater inside than outside, and if E be left open the water will therefore begin to flow out.

If, now, E were higher than B the same reasoning would show that the pressure outside was the greater, and therefore if E were opened the water would flow back into the vessel.

It has been taken for granted that the fluid reaches C and is therefore continuous from B to E. The pressure at C is less than that at B by that due to the height of C above B. The pressure at B is equal to that due to the height of a barometer made with the liquid in the vessel. Thus the height of C above B must not be so great as the height of this barometer, or else the air pressure would not be enough to hold up the column BC, in which case on A being opened some of the fluid in BC would flow back, leaving a Torricellian vacuum at C. In this case the siphon would not work, the air pressure not being great enough to carry the liquid over C.

11. Two mirrors are inclined to each other at right angles. Show that three images of an object placed in the angle between the mirrors are formed, and draw the pencil of rays by which the second image can be seen by an eye looking at one mirror.

Let OA, OB be the lines in which the mirrors are cut by a plane through some point P of the object perpendicular to the line of intersection of the planes of the mirrors.



Draw PN perpendicular to OB and produce it to P' so that PN = NP'.

Then rays from P after reflexion at OB will when produced backward pass through P' and hence P' will be a first image of P.

If now these rays, or any of them, be again reflected at OA they will on being produced backward pass through P'' if P' P'' be a line bisected at right angles (in N') by AO produced.

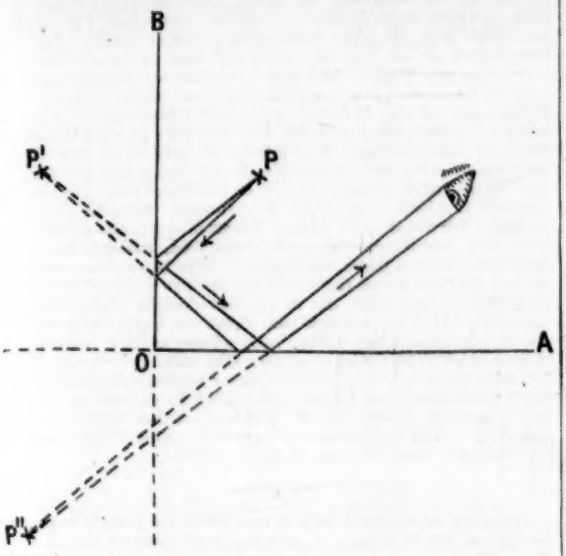
Thus P'' is a second image of P.

Since P'' is behind each mirror rays seeming to come from P'' cannot fall on the front of either mirror and therefore P'' gives no further image.

A third image P''' is given by reflexion in OA, such that PP''' is bisected at right angles by OA (in M).

Also P'' P''' is bisected at right angles by BO produced, and thus we get the image P''' after a reflexion at each mirror whichever reflexion takes place first.

We have then three images P′, P″, P‴ for each point of the object, and hence there will be three images of the whole.



The figure shows the path of a pencil of rays from P to the eye after reflexion at OB and OA.

12. What are the laws of the refraction of light? Describe some apparatus by which they can (approximately) be verified.

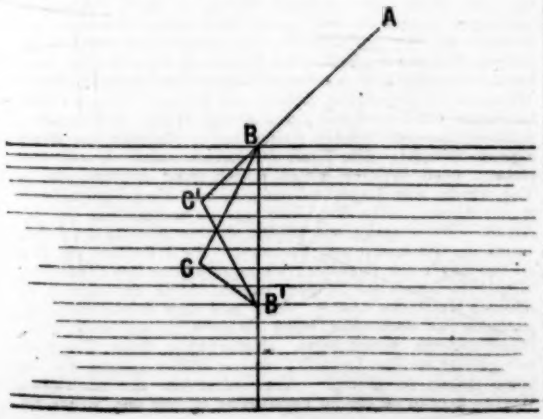
Law I.—The plane of refraction is the same as the plane of incidence.

Law II.—The sines of the angles of incidence and refraction are in a constant ratio.

'Let B′ be a slider travelling up and down a vertical stem. Let AC′ and BC be two rods pivoted on a fixed point B of the same stem. C′B′ and CB′ are two other rods jointed to the former at C and C′ and pivoted at their lower ends on the centre of the slider. BC is equal to B′C′, and BC′ to B′C. Hence the two triangles BCB′, B′C′B are equal in all positions of the slider, their common side BB′ being variable, while the other two sides of each are unchanged in length though not in position.

The ratio $\frac{BC}{CB'}$, or $\frac{B'C'}{C'B}$ is made equal to the index of refraction of the liquid in which the observation is to be made. For water this ratio will be $\frac{4}{3}$. Then if the apparatus be surrounded with water up to the level of B, ABC will be the path of a ray, and a stud at C will appear in the same line with the studs at A and B (to an eye in BA produced) for we have

$$\frac{\sin C'BB'}{\sin CBB'} = \frac{\sin C'BB'}{\sin C'B'B} = \frac{C'B'}{C'B} = \frac{4}{3}.' \quad (Deschanel.)$$



13. An object three inches in height is placed at a distance of six feet from a lens, and a real image is formed at a distance of three feet from the lens. The object is then placed one foot from the lens. Where, and of what height, will the image be?

The image being real, and formed by the rays after passing through the lens, must be on the other side from the object.

Thus, then, using the formula $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

we have in feet $u = 6$, $v = -3$.

Hence $\frac{1}{f} = -\frac{1}{2}$ and $f = -2$.

Thus if $u = 1$ we have

$$\frac{1}{v} - 1 = -\frac{1}{2},$$

$$v = 2.$$

Hence the image is two feet from the lens on the same side as the object.

Also, since the image is twice as far from the lens, it will be twice as high as the object, and therefore its height is 6 inches.

14. Describe experiments illustrating the difference between temperature and heat.

In 100 grammes of boiling water ($t = 100$) there are placed 20 grammes of ice, and the temperature falls to 70° when the ice is just melted. What is the latent heat of fusion of ice, assuming no heat to be lost?

'If ice at 0°C be put in a vessel and put on the fire it will be gradually melted by the *heat* which it gets from the fire; but if at any time while the melting is going on we take it off the fire and stir till the whole is at the same temperature, the *temperature* will be 0°C, as at first. The heat that has been taken in has left its effect in the shape of melting the ice, not in the shape of rise of temperature.'

In the same way when a kettle is boiling the heat which is used in turning the water into steam does not raise its temperature. If we find the temperatures of the two, we shall find them to be the same, namely, 100°C (at the normal pressure).

In bringing 100 grammes of water at 100° down to 70°, 3,000 thermal units are given up.

In raising 20 grammes of water from 0° to 70°, 1400 thermal units are given up.

Hence the rest, *i.e.*, 1600 units of heat, is used in melting 20 grammes of ice.

Thus, 80 units of heat are used in melting each gramme of ice.

∴ Latent heat of fusion of ice is 80.

15. Distinguish between saturated and unsaturated vapour.

What is meant by the statement that when the dew point is 20° C. the maximum pressure of aqueous vapour in the air is that due to 17·4 mm. of mercury?

There is a limit to the quantity of vapour which can be formed at a given temperature in an empty space. When this limit is reached the space is said to be saturated, as also the vapour. Below this limit the vapour is unsaturated.

The meaning of the statement is this: If we enclose a quantity of air without changing its pressure, and if we then take from it, by any means, all the aqueous vapour there is in it, we shall lessen its pressure by some quantity e. If, now, the temperature be 20° C., the greatest value of e (when the air is as full of vapour as it can be) is the pressure due to a column of mercury 17·4 millimetres high.

16. A building is heated by hot-water pipes; how does the heat get from the furnace of the boiler to a person in the building? What would be the effects on the temperature of the more distant parts of the building of coating the pipes near the boiler (*a*) with woollen felt, (*b*) with dull black lead?

The heat of the furnace is first *conducted* through the walls of the furnace into the water in the boiler.

The water in the boiler becomes warmer, and expands, thus becoming lighter. It then rises into the pipes, its place being taken by colder water from the pipes. A circulation is thus set up in the water by *convection*.

The water thus reaches the upper parts of the building (the boiler must be put at the bottom of the building), and flows about through metal pipes. The heat is *conducted* to the outer surface of these pipes and thence *radiated* into the air of the rooms.

(*a*) Woollen felt is a very bad conductor of heat, and by putting it round the pipes near the boiler the heat is kept from reaching the outer air near the boiler, and is the better kept in the pipes to heat other parts of the building.

(*b*) Dull black lead is a good radiator. Hence by coating the pipes with it we cause them to send off their heat faster, and thus by the loss of heat near the boiler other parts of the building are made colder.

German.

[Time, Three hours.]

A.

1. Translate into English:—

Erasmus von Rotterdam war ein kluger, feiner Mann voll Witz und Scharfsinn. Er wurde in seiner Jugend beredet, in ein Kloster zu gehen, obwohl seine ganze Natur sich dagegen sträubte. Durch den Beistand des Bischofs von Cambray erhielt er nach einiger Zeit seine Freiheit wieder und studirte nun in Paris Theologie. Hier fasste er einen solchen Widerwillen gegen die Theologie, wie sie damals gelehrt wurde, dass er sie, wie auch das Mönchswesen, sein ganzes Leben hindurch mit allen Waffen des Witzes bekämpfte. Bald erscholl sein Ruhm bei allen europäischen Völkern. Fürsten und Edelleute überhäuften ihn mit Einladungen Geschenken und Schmeicheleien; in allen Ländern begehrte man seiner, und suchte ihn durch glänzende Versprechungen zu locken. Aber er zog das freie Leben eines Literaten jedem Amte vor. Er bereiste alle Staaten des civilisirten Europa, hielt sich aber zuletzt meist in Basel auf, wo er in Verbindung mit dem Buchhändler Froben eine Menge Schriften herausgab. Unter seinen zahlreichen Schriften sind 'Das Lob der Narrheit' und die correcte Ausgabe des griechischen Neuen Testamentes, nebst lateinischer Übersetzung und Paraphrase die wichtigsten. Jene Schrift, eine volksthümliche Satire in lateinische Sprache, aber vielfach übersetzt, geisselte die Thorheiten aller Stände, besonders der Geistlichen und Mönche; sein neues Testament regte zum Studium der Heiligen Schrift in der Grundsprache an und förderte die Reformation. Als aber nach Luther's Auftreten der Kampf gegen das Alte eine grossartige Gestalt annahm, zog sich Erasmus furchtsam zurück, und bekämpfte Luther's Verfahren, das er anfangs gebilligt hatte. Erasmus hatte für die Leiden des Volkes kein Herz, und jede gewaltsame Bewegung füllte ihn mit Schrecken. Deshalb war er allen Demagogen feind und verschloss auch dem verfolgten Hutten, der in Basel bei seinem ehemaligen Freund vorsprechen wollte, die Thür.

A.

1. Erasmus of Rotterdam was a subtle, refined man, full of wit and acuteness. He was persuaded in his youth to enter a cloister, though his whole nature was opposed to it. By the assistance of the Bishop of Cambray he recovered his liberty after some time, and then studied theology in Paris. Here he conceived such an antipathy against theology, as it was then taught, that he opposed it, as also monasticism, throughout his whole life, with all the weapons of his wit. Soon his fame resounded among all European peoples. Princes and nobles loaded him with invitations, presents, and flatteries. In all lands men sought for him and tried to entice him by splendid promises, but he preferred the free life of a man of letters to every office. He travelled through all the States of civilized Europe, but ultimately confined himself chiefly to Basle, where, in connection with the bookseller, Froben, he published a multitude of writings. Among his numerous writings the 'Praise of Folly,' and the correct edition of the Greek New Testament, with a Latin translation and paraphrase, are the most important. The former piece, a popular satire in the Latin tongue, but many times translated, lashed the follies of all classes, especially of the parsons and monks. His new Testament incited men to the study of the Holy Scripture in the original tongue and promoted the Reformation. But when after Luther's appearance the struggle against the old *régime* assumed a serious aspect, Erasmus drew himself timidly back and opposed Luther's conduct, which at first he had favoured. Erasmus had no sympathy with the sorrows of the people, and every mighty movement filled him with apprehension. Therefore he was the foe of all the demagogues, and even shut the door to the persecuted Hutten, who wished to visit his former friend in Basle.

B.

Sehr lange ist mir die Zeit geworden, die mir kein Lebens-Zeichen von Then gebracht. Ich habe das Unglück zwar schon von weitem geahnt, weil die Kälte gar zu streng war,—aber es ist doch, als sollte es nicht sein, dass wir so lange nichts von einander hören. Für die mannigfaltigen interessanten Nachrichten, die Sie beide mir von Ihren Beschäftigungen geben, kann ich Ihnen nichts ähnliches erwidern, denn meine Existenz war bisher noch die alte—Arbeit ohne geistigen Genuss. Das Dringendste ist seit gestern vorbei, und nun werde ich auch mehr Menschen sehen. Aber eine Nachricht von mir kann und muss ich Ihnen doch geben, weil sie leider eine meiner Schönsten Hoffnungen für eine Zeitlang zu Grunde richten wird. Es ist beinahe schon richtig, dass ich als Professor der Geschichte künftiges Frühjahr nach Jena gehe. So sehr es im ganzen mit meinen Wünschen übereinstimmt, so wenig bin ich von der Geschwindigkeit erbaut, womit es betrieben wird, aber der Abgang Eichhorns machte es in mehrerem Betracht nothwendig. Ich selbst habe keinen Schritt in der Sache gethan, habe mich aber überraschen lassen; und jetzt, nachdem es zu spät ist, möchte ich gerne zurücktreten. Man hatte mich vorher sondirt, und gleich den Tag darauf wurde es an unseren Herzog nach Gotha geschrieben, der es an dem dortgen Hofe gleich einleitete. Also die schönen paar Jahre von Unabhängigkeit, die ich mir träumte, sind dahin; mein schöner kuntiger Sommer in Rudolstadt ist auch fort; und dies alles soll mir ein heilloser Katheder ersetzen! Das Beste an dieser Sache ist doch immer die Nachbarschaft mil Ihnen. Ich rechne darauf, das Sie mir eine himmlische Erscheinung in Jena sein werden, weil ich das erste Jahr zu viel zu thun und zu lesen habe, um noch etwas für die Wünsche meines Herzens übrig zu behalten.

B.

Very long has the time been to me, which has brought to me no sign of life from you. I, indeed, already scented the misfortune from afar, because the cold was really too intense; but still it is as it ought not to be, that we should be so long without hearing from each other. For the many kinds of interesting accounts which you two give me of your occupations, I can give you nothing similar in return, for my existence has hitherto been the old one, work without inward enjoyment. The most pressing part of it is, since yesterday, past; and now also I shall again see men; but I can, and indeed must, give you one piece of news about myself, because, alas, it will overthrow one of my dearest hopes for some time. It is already nearly fixed that I should go next spring to Jena as Professor of History. Well as on the whole it harmonises with my wishes, so little am I edified with the haste in which it is being managed; but the resignation of Eichhorn made it necessary from many points of view. I myself have not taken a step in the matter, but I have let myself be taken unawares, and now, when it is too late, I would willingly retreat. I had been previously sounded, and the very next day a letter was written to our Duke in Gotha, who immediately introduced it at the court there. Thus the beautiful two years of independence which I dreamed of for myself are gone; my beautiful next summer in Rudolstadt is also out of the question; and for all this a villainous chair is to compensate me! The best thing in this business is, after all, always my nearness to you. I reckon upon this, that you will be to me a heavenly vision in Jena, since I shall have in my first year too much to do and to read to keep anything over for the wishes of my heart.

C.

Mathilde, die Gemahlin des deutschen Königs Heinrich I. endete ihr reiches Leben im Jahre 968. Viele Jahrhunderte hat ihr Name in höchsten Ehren in ihren zahlreichen Stiftungen fortgelebt, und gewiss mit vollstem Rechte. Ihr Beispiel und ihre unermüdliche Thätigkeit haben mehr für die sittliche Hebung des Volkes der Sachsen gethan, als man sagen kann. Die von ihr gestifteten Klöster und Schulen waren Mittelpunkte christlichen Lebens und höherer Bildung; den verfolgten boten sie Schutz, den Armen Hilfe. Wie in diesen Klöstern gewirkt werden sollte, zeigte Mathilde an ihrem eigenen Beispiel. Alle Kraft des Lebens nahm sie aus dem Gebet; noch in ihren letzten Jahren stand sie stets, ehe es Tag wurde, vom Lager auf und ging zum Morgengottesdienst in die Kirche. Den Tag über wâr sie unermüdlich bei der Arbeit. Wo sie auch sein möchte, daheim oder auf der Reise, suchte sie die armen auf, unterstützte die Wanderer und trat an das Lager der Kranken; sie unterrichtete ihre Diener und Mägde in nützlichen Dingen, namentlich in der damals so seltenen Kunst des Lesens. Und alle diese Werke der Liebe genügten ihr doch nicht, wenn sie nicht täglich noch selbst Hand an eine Arbeit legte. Keine unter ihren Tugenden war grösser als ihre Demuth; wo sie helfen konnte, war ihr keine Arbeit zu gering. Aber selbst bei den niedrigsten Werken konnte sie die ihr angeborene Hoheit und Würde nie

verläugnen. 'Wie eine Königin sass sie inmitten des Volkes, aber sie tröstete Alle, die Leid trugen.' Mit ehrfurchtsvoller Bewunderung sah die Mitwelt auf sie, die Gemahlin König Heinrichs, die Mutter des grossen Kaisers Otto, und mit Stolz sollten wir Deutsche noch jetzt ihren Namen nennen.

C.

Matilda, the consort of the German King Henry I., ended her fruitful life in the year 968. During many centuries has her name survived in the highest honour in her numerous foundations, and certainly with the fullest justice. Her example and her tireless energy did more for the moral advancement of the Saxon people than can be told. The cloisters and schools founded by her were centres of Christian life and higher culture; to the persecuted they offered shelter, to the poor help. Matilda showed by her own example how the affairs of these cloisters should be carried on. All the force of her life she gained from prayer; even in her last years she constantly rose from her couch before it was day, and went to church to matins. During the day she was indefatigable in work. Wherever she might be, at home or on a journey, she sought out the poor, supported the wanderers, and visited the couches of the sick. She instructed her servants and maidens in useful things, especially in the art of reading, then so rare. And all these works of love sufficed her not, unless she herself daily put her hand to some work. None of her virtues was greater than her humility; where she could help, no work was too low for her. But even in the lowliest tasks she could never belie her native majesty and quality. 'As a queen she sat among the people; but she comforted all who were in sorrow.' With respectful wonder did her contemporaries gaze upon her, the consort of King Henry, the mother of the great Emperor Otho; and with pride ought we Germans even now to mention her name.

II.—GRAMMATICAL QUESTIONS.

A.

1. Decline in both numbers Derselbe grosse Künstler, die höhere Tugend, geschliffenes Glas.

N.	Derselbe	grosse	Künstler
G.	Desselben	grossen	Künstlers
D.	Demselben	grossen	Künstler
A.	Denselben	grossen	Künstler
N.	Dieselben	grossen	Künstler
G.	Derselben	grossen	Künstler
D.	Denselben	grossen	Künstlern
A.	Dieselben	grossen	Künstler

N. A.	Die	höhere	Tugend	Die höheren Tugenden
G.	Der	höheren	Tugend	Der höheren Tugenden
D.	Der	höheren	Tugend	Den höheren Tugenden

N. A.	Geschliffenes	Glas	Geschliffene Gläser
G.	Geschliffenen	Glases	Geschliffener Gläser
D.	Geschliffenem	Glas	Geschliffenen Gläsern

2. What is the gender of nouns terminating in -schaft, -niss, -er, -ung, -sal, -el? Give examples for each termination, and mention exceptions.

Nouns in -schaft and -ung are feminine, as die Freundschaft, die Wissenschaft, die Hoffnung, die Erfahrung. These are usually *derivative*, and denote qualities. The exceptions are das Petschaft, the seal, and der Hornung, an old word for February.

Nouns in *-sal* are usually neuter, as das Schicksal; but die Trübsal, sorrow, and die Drangsal, vexation, are feminine.

Nouns in *-niss* are also neuter, as das Zeugniss, das Geheimniss; but die Kenntniss, knowledge, and die Besorgniss, fear, are feminine.

Nouns in -el and -er are perhaps usually masculine: as der Vater, der Löffel, der Himmel, der Hammer; but many are neuter as das Feuer, das Messer, das Wasser, das Silber; das Mittel. Some in -er are feminine, die Mutter, die Schwester, die Tochter.

3. Give the second person singular of the imperfect, indicative and subjunctive, and the past participle of:

denken	dachte	dachte	gedacht
leiden	litt	litte	gelitten
scheiden	schied	schiede	geschieden
rufen	ruf	rufe	gerufen
laufen	lief	liefe	gelaufen
rennen	rannte	rannte	gerannt
verderben	verdarb	verdärbe (verdürbe)	verdorben
messen	mass	mässe	gemessen

4. State the moods and tenses in which the separable prefix of compound verbs stands *after* the verb. Give examples. Which of the following verbs are separable: fortgehen, unterliegen, vollziehen, widerlegen, anerkennen?

The prefixes are detached in the Present and Imperfect Indicative, and in the Imperative; as Ich *gehe* diesen Abend *aus*; ich gab das Geld ab; er stellte das Ding dar; schreibe einen Brief ab.

fortgehen is separable; *unterliegen* separable with *sein*; also insep.; *vollziehen* inseparable; *widerlegen* inseparable; *anerkennen* inseparable.

5. Give the first person singular of the perfect indicative of dürfen, gehen wollen, lernen lassen; and the second person plural of the pluperfect subjunctive of mögen, kommen dürfen, bleiben sollen.

Ich habe gedurft when alone; when another verb is present, it is 'ich habe .... dürfen.'
Ich habe gehen wollen.
Ich habe lernen lassen.
Sie hätten gemocht, alone; Sie hätten, mögen ..... with another verb.
Sie hätten kommen dürfen.
Sie hätten bleiben sollen.

B.

1. Mention the German nouns expressing measurement (extent, weight, or quantity) which, after numerals, stand in the singular instead of the plural, and those which are used in the plural.

Masculine and neuter nouns are in the singular, as der Fuss, der Zoll, der Grad, das Pfund, das Paar, das Dutzend, das Buch, der Mann, das Stück, *e.g.*, neun Stück Tuch, nine pieces of cloth.

Feminine nouns take a plural, as Vier Ellen Tuch, four yards of cloth; zehn Flaschen Wein, ten bottles of wine.

2. Supply the cases governed by the impersonal verbs:

Es gelüstet *mich*, accus., *I desire.*
Es schwindelt *mir*; dative; I am giddy.
Es graut *mir* or es graut mir vor, I hate, detest.
Es friert *mich*, accus.; I am cold.

3. Mention four verbs governing an accusative of the person and genitive of the thing; and three verbs which govern two accusatives.

Of the first kind are berauben, versichern, überheben; and many reflexives, as sich erinnern, to remember (eines Dinges); sich erfreuen, to enjoy; sich erbarmen, to pity; sich annehmen, to interest oneself in.

Of the second are nennen, heissen, schimpfen.

4. Give the three German conjunctions which answer to the English *but*, and illustrate their different uses.

Sondern can only be used if the antecedent clause contains a negative, and in a clause which only completes the first, but is not independent by itself.

Nicht ich bin krank, *sondern* mein Vater.
Ich liebe nicht ihn, *sondern* seine Nichte.

If the second clause has its own subject and verb, even after a negation, *aber* is used.

Ich habe ihn nicht selbst gesehen, *aber* ich habe ihm geschrieben.

In all other cases *aber* or *allein* is used indifferently.

Er wollte aufstehen, aber (allein) er konnte nicht.

5. Translate:

In December the days are shortest.
Im Dezember sind die Tage am kürzesten.
This poem is by far the best.
Dieses Gedicht ist bei weitem am besten.
He is much older than you.
Er ist viel älter als sie.
He was more bold than prudent.
Er war mehr kühn als vorsichtig.
He was advised to be careful.
Man rieth ihm dass er besorgt wäre.

A.

1. Translate:—

Im Jahre 1783 kam der für die Amerikaner ebenso vortheilhafte als ehrenvolle Friede zu Stande, der die Freiheit und Unabhängigkeit ihres Vaterlandes für immer fest gegründet hat. Laut und unermesslich war der Jubel der das

befreite Land erfüllte. Aller Augen aber blickten mit Bewunderung und Stolz, mit Liebe und freudiger Begeisterung auf Washington. Ihm vorzüglich verdankte man den glänzenden Erfolg. Sein grosses Werk war vollendet, und nun zog er sich in die Einsamkeit des Landlebens zurück, nicht ohne zuvor herzlichen Antheil an der allgemeinen Freude genommen zu haben. Dann legte er seine Würde feierlich nieder und nahm von seinen Waffengefährten einen rührenden Abschied. Die erprobten Krieger vergossen Thränen, als er aus der Barke, die ihn in seine Heimath bringen sollte, ihnen das letzte Lebewohl zurief. Zuvor jedoch erschien Washington noch vor dem Congresse, und hielt hier vor einer unzählbaren Menge Zuhörer seine feierliche rührende Abschiedsrede. Der Präsident des Congresses antwortete darauf und schloss mit den Worten: 'Nachdem Sie die Freiheit in dieser neuen Welt vertheidigt, den Unterdrückten und Unterdrückern eine heilsame Lehre gegeben haben, treten Sie, von den Segnungen Ihnen Mitbürger begleitet, von dem grossen Schauplatze wieder ab. Aber der Ruhm Ihrer Thaten wird nicht mit Ihrer Würde aufhören, er wird fortdauern und die fernsten Geschlechter unserer Nachkommen begeistern. Mögen Ihre künftigen Tage ebenso glücklich sein, als Ihre bisherigen ruhmvoll gewesen sind.' Die Äusserungen des Dankes und der Begeisterung für den herrlichen Mann, und des Schmerzes um sein Scheiden ehrten ihn würdiger als je ein Held der Vorzeit und der Gegenwart durch prunkvolle Feste, durch den Mund der Dichter, durch Lobpreisungen der Schmeichler gefeiert worden ist.

A.

In the year 1783 came to pass the peace which was for the Americans equally advantageous and honourable, which has for ever fixed firm the freedom and independence of their country. Loud and unbounded was the joy which filled the liberated nation, but the eyes of all looked with wonder and pride, with love and joyful enthusiasm on Washington. To him especially was owing the splendid result of the war. His great work was ended, and now he drew himself back to the solitude of country life, not without first having taken a hearty share in the general rejoicing. Then he laid his dignity solemnly down and took a moving leave of his comrades in arms. The proved warriors shed tears as he uttered to them the last farewell from the bark which was to bring him to his home. Yet Washington appeared again before the Congress and delivered there before an innumerable crowd of hearers his solemn moving farewell address. The President of Congress answered it, and concluded with the words: 'After you have defended liberty in this new world, and have given to oppressors and oppressed a wholesome lesson, you retire from the great scene attended by the blessings of your fellow-citizens. But the glory of your deeds will not cease with your dignity; it will endure, and inspire the most distant generations of our successors. May your future days be as happy as your days hitherto have been glorious!' The expressions of thanks and of enthusiasm for the noble man, and of pain at his departure, honoured him more worthily than ever a hero of old time and of the present has been glorified by splendid feast, by the mouth of poets, or by the adulations of flatterers.

B.

Um das Jahr 1440 erreichten die Portugiesen den Fluss Senegal. Hier fanden sie zum ersten Male wilde heidnische Neger; die Neger, welche sie weiter gegen Norden getroffen hatten, waren alle Mohamedaner gewesen. Nahe an der Mündung des Senegal liegt das grüne Vorgebirge, und vor diesem zehn Inseln, welche man die capverdischen oder Inseln des grünen Vorgebirges genannt hat. Dahin kamen die Portugiesen im Jahre 1447. Diese Inseln sind sehr gebirgig, haben aber eine so warme Luft, dass die niedrigen Gegenden mit immergrünen Bäumen bedeckt sind. Es währte übrigens bis 1462, ehe man die Küste des eigentlichen Guinea entdeckte. Nun war man bis in die gefürchtete Gegend des Aequators gekammen, ohne von der Sonnenhitze verbrannt zu sein. Man fand hier Gold, Elfenbein und andere Kostbarkeiten, so dass in den nächsten Jahren die Schiff fahrt nach Afrika sehr zunahm. Alle diese Entdeckungen, von Porto Santo bis Guinea, eine Strecke von 500 geographischen Meilen, verdanken wir Prinz Heinrich dem Seefahrer. Wenn er auch nicht selbst mitschiffte, so wurden doch alle jene Fahrten nach seinen Entwürfen vorgenommen, und welche Freude muss der Prinz empfuncten haben, dass ein so herrlicher Erfolg seine Entwürfe krönte! Er war es, der den Grund zur Grösse und Macht des kleinen Königreichs Portugal legte, denn eine Zeit lang war dieser Staat der blühendste und mächtigste Handelsstaat in Europa. Seine Pläne wurden von dem König Johann II. mit grossem Eifer fortgeführt. Er liess auf Guinea Kolonien und Festungen anlegen und von dort Schiffe auf weitere Entdeckungen ausgehen. Ein kühner Mann, Bartholomäus Diaz, schiffte immer weiter nach Süden und erreichte 1486 die Südspitze Afrikas, die er wegen der gefährlichen Stürme 'Vorgebirge der Stürme' nannte. Aber der König, sobald er davon hörte, rief voll freudigen Vertrauens, 'Nein, wir wollen es das Vorgebirge der guten Hoffnung nennen.'

B.

About the year 1440 the Portuguese reached the river Senegal. Here they found for the first time wild heathenish negroes; the negroes whom they had met further towards the north had all been Mohammedans. Close to the mouth of the Senegal lies the green promontory, and opposite this ten islands, which are called the Cape Verdes, or islands of the green promontory. The Portuguese came thither in the year 1447. These islands are very mountainous, but have such a warm air that the lower districts are covered with evergreen trees. It was not, however, till 1462 that the coast of Guinea proper was discovered. Now men had reached the dreaded region of the equator without being burnt up by the heat of the sun. Here were found gold, ivory, and other precious rarities, so that in the following years the voyage to Africa was very attractive. All these discoveries, from Porto Santo to Guinea, a stretch of five hundred geographical miles, we owe to Prince Henry the Voyager. Although he himself took no part in the expeditions, yet all of these voyages were undertaken at his instance, and what a joy must the Prince have felt that so splendid a result crowned his designs! He it was who laid the foundation of the greatness and power of the little kingdom of Portugal; for during a long time this state was the most flourishing and most powerful commercial state in Europe. His plans were carried out by King John II. with great zeal. He directed the foundation of colonies and fortresses in Guinea, and the departure from thence of ships for further discoveries. A bold man, Bartholomew Diaz, voyaged ever further to the south, and in 1486 reached the southern point of Africa, which he named the Cape of Storms on account of the dangerous tempests. But the king, as soon as he heard of it, full of joyous confidence, cried, 'No, we will call it the Cape of Good Hope.'

C.

'Lass doch die Arbeit ruen, Wilko, und gehe mit uns! Alle Welt strömt vor das Brandenburger Thor, um den Burggrafen zu sehen, der heute seinen Einzug in Berlin hält.' Mit diesen Worten trat die Frau des Webermeisters—es war im Juli, 1412— in die Werkstätte ihres Mannes. 'Lass andere vor das Thor laufen, wenn sie wollen—ich habe keine Zeit, Feiertag zu machen! Was geht mich auch der Burggraf an?' erwiderte der Meister. 'Die grossen Herren haben die Schlösser alle in der Hand,—wie sollte der Hohenzoller, der von Nürnberg her fremd in's Land kommt, etwas wider sie vermögen?' Haben ihm nicht sogar etliche vom Rathe der Stadt den Einzug verweigern wollen?' Am andern Tag aber musste der Meister mit den andern Bürgern vor dem Burggrafen, den der Kaiser zum Markgrafen von Brandenburg gemacht hatte, erscheinen, um den Eid der Treue zu schwören. Als er zum Mittagessen zurückkam, sah die Frau dass eine Veränderung mit ihm vorgegangen war. 'Welch ein Mann,' ruf er aus, 'ist dieser Burggraf! Einen König könnnte er vorstellen! Ja, wenn einer unserem Lande Frieden wiederzugeben vermöchte, so müsste er es sein.' Und bald zeigte der Hohenzoller, wie es ihm ernst war mit der Wiederherstellung der Ordnung. Die Ritterburgen waren längst Räuberburgen geworden. Der Markgraf zog im Lande umher und verlangte von den Rittern sich ihm zu unterwerfen. Die welche es nicht freiwillig thaten, zwang er mit dem Schwert. Wo unrecht geschehen war, half er den unterdrückten zum Recht. Auch Wilko, dem fast alles geraubt worden war, wurde zu dem Markgrafen gerufen und musste genau den Hergang erzählen. Es wurde ihm voller Ersatz des erlittenen Schadens verheissen. 'Ist's möglich,' sagte seine Frau, als er zurückkam, 'hat die böse Zeit fur uns ein Ende?' 'Sie hat ein Ende,' entgegnete er, für unser Haus und für das ganze Land.'

C.

'Let your work alone, Wilko, and go with us! The whole world is streaming before the door of the Brandenburgs, to see the Burgrave, who to-day is holding his entrance into Berlin.' With these words the wife of the master-weaver—it was in July, 1412—entered the workshop of her husband. 'Let others run before the door, if they like—I have no time to keep holiday! What have I to do with the Burgrave?'—answered the master. 'The great lords have their castles all in their hand—how could the Hohenzoller, who is coming a stranger from Nürnberg into

the land, have any power against them? Have not even some of the council of the town wished to deny him the entrance?' But on the next day the master was forced with the other burghers to appear before the Burgrave, whom the Emperor had made Margrave of Brandenburg, to swear the oath of fealty. When he came back to dinner, the wife saw that an alteration had come upon him. 'What a man,' cried he, 'this Burgrave is! He could stand for a king! Yes, if any one could give back peace to our country, he must be the man.' And soon the Hohenzoller showed how serious a point with him was the restoration of order. The knights' castles had long been the holds of robbers. The Margrave made expeditions in the country, and demanded of the knights to submit themselves to him. Those who did not do so willingly, he compelled with the sword. Where injustice had been done, he brought justice to the oppressed. Even Wilko, who had been robbed of nearly everything, was called to the Margrave, and required to relate the circumstances accurately. He was promised full compensation for the injury he had suffered. 'Is it possible?' said his wife, as he returned; 'is the evil time ended for us?' 'It is ended,' replied he, 'for our house and for the whole land.'

II. (1) Give the gender, genitive singular, and nominative plural of—

Hase	Masculine	Gen. Hasen	Plur. Hasen
Hirsch	Masc.	Hirsches	Hirsche
Wald	Masc.	Waldes	Wälder
Feld	Neut.	Feldes	Felder
Gemälde	Neut.	Gemäldes	Gemälde
Frucht	Fem.	Frucht	Früchte
Biene	Fem.	Biene	Bienen
Acker	Masc.	Ackers	Äcker

(2) Decline, in both numbers—

Unser junger Bruder: Eure Nachbarin: dieses schwere Schicksal, kleine Hütte.

unser junger Bruder	unsere jungen Brüder
unseres jungen Bruders	unserer jungen Brüder
unserem jungen Bruder	unseren jungen Brüdern
unseren jungen Bruder	unsere jungen Brüder
Eure Nachbarin	Eure Nachbarinnen
Eurer Nachbarin	Eurer Nachbarinnen
Eurer Nachbarin	Euren Nachbarinnen
Eure Nachbarin	Eure Nachbarinnen
Dieses schwere Schicksal	Diese schweren Schicksale
Dieses schweren Schicksal	Dieser schweren Schicksale
Diesem schweren Schicksal	Diesen schweren Schicksalen
Dieses schwere Schicksal	Diese schweren Schicksale
Kleine Hütte	Kleine Hütten
Kleiner Hütte	Kleiner Hütten
Kleiner Hütte	Kleinen Hütten
Kleine Hütte	Kleine Hütten

(3) Decline es, was, jemand, niemand. Are there any indefinite pronouns which are indeclinable.

N. Es	N. was
G. (seiner) dessen, desselben	G. wessen
D. (ihm; usu. the preposition following *da*; as davon)	D. was
A. Es	A. was
N. A. Jemand	Niemand
G. Jemandes Jemands	Niemandes Niemands
D. Jemand Jemanden	Niemand Niemanden.

Among the indefinite pronouns man, einander, selbst (selber) etwas, nichts, are indeclinable.

(4) Translate:

In the year 754, B.C. Im Jahr siebenhundert vier und fünfzig vor Christus.

About four o'clock. Um vier Uhr.

A quarter past ten. Ein Viertel nach zehn (or auf elf).

Two miles and a half. Dritthalb Meilen, or zwei Meilen und eine halbe.

For the third time. Für dem dritten Male; drittens, &c.

On the 22nd of March. Am zwei und zwanzigsten März.

(5) Write down the second person singular of the imperfect and perfect indicative of

frieren	du frorst	du hast gefroren
studieren	du studiertest	du hast studiert
beweisen	du beweistest	du hast beweist
berathen	du beriethest	du hast berathen
treffen	du trafest	du hast getroffen
heissen	du hiessest	du hast geheissen
dringen	du drangest	du bist gedrungen
verlesen	du verlasest	du hast verlesen

(6) Give the first person singular of all the tenses of the passive voice of lehren.

Indic. Pres. Ich werde gelehrt. Impf. Ich wurde gelehrt. Perf. Ich bin gelehrt worden. Plupf. Ich war gelehrt worden. Fut. 1st, Ich werde gelehrt werden; 2nd, Ich werde gelehrt worden sein.

Subj. Pres. (dass) ich gelehrt werde. Impf. ich würde gelehrt. Perf. Ich sei gelehrt worden. Plupf. (wenn) ich gelehrt worden wäre.

Conditional, 1st, ich würde gelehrt werden. 2nd, ich würde gelehrt worden sein, or, ich wäre gelehrt worden.

(7) Mention three or four intransitive verbs which may take either *haben* or *sein* as their auxiliaries, with different meanings.

abtreten (haben), to yield up; abtreten (sein) to go away.

bestehen (haben), to stand a test; bestehen (sein) to consist of.

fortfahren (haben), to continue; fortfahren (sein) to go off in a carriage.

(8) Enumerate the prepositions which govern sometimes the dative and sometimes the accusative, and form short sentences to show the different uses of these cases.

an, auf, hinter, in, neben, über, unter, vor, zwischen.

The dative denotes *rest*, the accusative, motion towards.

Wir stehen an dem Fuss des Berges; we stand *at the foot* of the mountain. Das Heer zog an den Fuss des Berges; the army moved *to the foot* of the mountain.

Er war auf dem Kopf der Regierung; he was at the head of the administration. Er setzte seinen Hut auf den Kopf; he put his hat on his head.

Der Hof ist neben dem Haus; the yard is by the house.

Ich legte das Buch neben mich; I laid the book beside me.

Ich stand vor dem aufgang der Sonne auf; I rose *before* sunrise.

Die Truppen rückten vor die Stadt; The troops marched to the town.

(9) Translate:—

He went to Nice. Er gieng nach Nice.

They came to me. Sie kamen zu mir.

Will you write to me? Wollen Sie mir schreiben?

Do not say so. Sage es nicht.

Who has been with you this morning? Wer ist dieses Morgens mit dir gewesen?

French.

1. Translate into English *Two*, and not more than two, of the following passages:—

A.

Napoléon et Junot.

'On sait que mon père était criblé de blessures. Une d'entre elles qui fut, sans contredit, cause de la funeste maladie à la suite de laquelle il succomba, est la balle qu'il reçut au-dessus du nez, aux lignes de *Torres Vedras*. Pour extraire la balle, on fut obligé d'ouvrir la joue au-dessus de la pommette maxillaire; cette cicatrice, jointe à celle de la blessure elle-même, avait grandement dérangé l'harmonie des lignes de son visage. L'empereur, à qui la belle convention de *Cintra* avait déplu, uniquement parce que c'était une capitulation, témoigna a mon père une mauvaise humeur marquée. Au cercle (*drawing-room*) un jour, il lui dit tout haut: 'Mon Dieu, Junot, comme cette blessure l'a rendu laid!' 'Mon père ne répondit rien la première fois; mais, rentré chez lui, pleura amèrement sur cette dure parole de le par celui qu'il aimait tant. Il n'en parla pas même a ma mère.

Au cercle suivant, même compliment de l'empereur, et, comme on le pense, douleur encore plus vive de la part de mon pauvre père. Cette fois seulement, il versa son chagrin dans le sein de ma mère. Elle fut indignée de cette injustice de l'empereur, et elle conseilla à mon père de répondre quelque chose si l'attaque si renouvelait.

Cela ne manqua pas: pour la troisième fois, mon père fut salué de l'exclamation sur sa laideur occasionnée par la blessure dont j'ai déjà parlé. 'Je suis désolé de n'être pas du même sentiment que l'empereur,' dit respectueusement mon père; 'mais j'avais cru que cette blessure avait dû m'embellir, puisque j'avais eu le bonheur de la recevoir au service de Votre Majesté.'

Napoléon fil une grimace et passa a un autre.—*D' Abrantès.*

Napoleon and Junot. It is well-known that my father was riddled with wounds. One of them which was, without contradiction, the cause of the fatal illness to which he finally fell a prey, was the shot which he received above the nose, at the lines of Torres Vedras. To extract the shot, they were forced to open the cheek above the maxillary cheek-bone; this scar, combined with that of the wound itself, had seriously disturbed the harmony of the lines of his countenance. The Emperor, whom the fine Convention of Cintra had displeased, solely because it was a capitulation, showed to my father a marked ill-humour. In the drawing-room, one day, he said to him quite loud, 'Really, Junot, how ugly that wound has made you!' My father answered not a word the first time, but, when he had returned home, he wept bitterly over this hard word spoken by him he loved so well. He did not speak of it even to my mother.

At the following drawing-room, there was the same compliment from the Emperor, and, as one may suppose, still more acute sorrow on the part of my poor father. This time only, he poured his grief into the bosom of my mother. She was indignant at this injustice of the Emperor, and she advised my father to make some reply if the attack were renewed.

The attack did not fail to come; for the third time my father was saluted with the exclamation on his ugliness caused by the wound of which I have already spoken. 'I am sorry not to be of the same opinion as the Emperor,' said my father respectfully; 'but I had thought that this wound ought to have adorned me, inasmuch as I had had the happiness to receive it in the service of your majesty.'

Napoleon made a grimace and passed on to another.

B.

3. *Evasion de lord Nithisdale.*—Après l'entreprise malheureuse du roi Jacques pour remonter sur le trône d'Angleterre, les seigneurs anglais qui avaient embrassé son parti furent condamnés à périr par la main du bourreau. On les exécuta le 16 mars, 1716. Lord Nithisdale devait subir le même sort; mais il se sauva par la tendresse ingénieuse de son épouse. On avait permis aux femmes de voir leurs maris la veille de leur mort, pour leur faire les derniers adieux. Milady Nithisdale entra dans la Tour, appuyée sur deux femmes de chambre, un mouchoir devant les yeux, et dans l'attitude d'une femme désolée. Lorsqu'elle fut dans la prison, elle engagea le lord, qui était de même taille qu'elle, de changer d'habits, et de sortir dans la même attitude qu'elle avait en entrant; elle ajouta que son carrosse le conduirait au bord de la Tamise, où il trouverait un bateau qui le mènerait sur un navire prêt à faire voile pour la France. Le stratagème s'exécuta heureusement. Milord Nithisdale disparut, et arriva à trois heures du matin à Calais. En mettant pied à terre, il fit un saut, en criant, 'Dieu soit loué, me voilà sauvé!' Ce transport le décela; mais il n'était plus au pouvoir de ses ennemis. Le lendemain matin on envoya un ministre pour préparer le prisonnier à la mort; ce ministre fut étrangement surpris de trouver une femme au lieu d'un homme. Le lieutenant de la Tour consulta la cour pour savoir ce qu'il devait faire de milady Nithisdale. Il reçut orde de la mettre en liberté, et elle alla rejoindre son mari en France. —*Panckoucke.*

The escape of Lord Nithisdale.—After the unfortunate enterprise of King James to re-ascend the throne of England, the English lords who had espoused his cause were condemned to die by the hand of the executioner. They were executed on the 16th of March, 1716. Lord Nithisdale was to undergo the same fate; but he was saved by the ingenious affection of his wife. The wives had been allowed to see their husbands on the eve of their death, to take their last farewells. Lady Nithisdale entered the Tower, supported by two lady's maids, with a handkerchief before her eyes, and in the attitude of a woman overwhelmed with grief. When she was in the prison, she induced her lord, who was of the same height as herself, to change clothes, and to go out in the same attitude which she had shown while entering; she added that her carriage would bring him to the side of the Thames, where he would find a boat which would carry him to a ship ready to set sail for France. The stratagem was successfully carried out. Lord Nithisdale disappeared, and arrived at Calais at three o'clock in the morning. When putting his foot to the earth he leapt up, crying, 'God be praised; I am saved!' This burst of joy discovered him; but he was no longer in the power of his enemies. The next morning a messenger was sent to prepare the prisoner for death; the messenger was strangely surprised to find a woman instead of a man. The lieutenant of the Tower consulted the Court to know what he must do with Lady Nithisdale. He received orders to set her at liberty, and she went to rejoin her husband in France.

C.

Don Pèdre, roi de Castille, et le magistrat.—Le roi don Pèdre, que nous nommons *le Cruel*, et que la reine Isabella la Catholique n'appelait jamais que *le Justicier*, aimait à se promener le soir dans les rues de Séville, cherchant les aventures, comme le calife Haroun-al-Raschid. Certaine nuit, il se prit de querelle, dans une rue écartée, avec un homme qui donnait une sérénade à une dame. On se battit, et le roi tua le cavalier amoureux. Au bruit des épées, une vieille femme mit la tête à la fenêtre, et èclaira la scéne avec la petite lamp qu'elle tenait à la main. Il faut savoir que le roi don Pèdre, d'ailleurs leste et vigoureux, avait un défaut de conformation singulier: quand il marchait, ses rotules (*knee-joints*) craquaient fortement. La vieille, à ce craquement, n'eut pas de peine à le réconnaître. Le lendemain, le chef de l'autorité municipale vint faire son rapport au roi. 'Sire, on s'est battu en duel, cette nuit, dans telle rue. Un des combatants est mort.' 'Avez-vous découvert le meurtrier?' 'Oui, sire.' 'Pourquoi n'est-il pas déjà puni?' 'Sire, j'attends vos ordres.' 'Exécutez la loi.' Or le roi venait de publier un décret portant que tout duelliste serait decapité, et que sa tête demeurerait exposée sur le lieu du combat. Le magistrat se tira d'affaire en homme d'esprit: il fit scier la tête d'une statue du roi, et l'exposa dans une niche au milieu de la rue, theâtre du meurtre.—*Mérimée.*

The king Don Pedro, whom we call 'the cruel,' and whom Queen Isabella, the catholic, never called anything but 'the Justiciary,' was wont to walk the streets of Seville in the evening, seeking for adventures, like the Caliph Haroun-al-Raschid. One night he fell into a quarrel, in a lonely street, with a man who was serenading a lady. They fought, and the king killed the amorous cavalier. At the noise of swords, an old woman put her head to the window, and illuminated the scene with the little lamp which she held in her hand. It must be understood that the king Don Pedro, otherwise active and vigorous, had a peculiar defect in his bodily conformation; when he walked his knee-joints cracked loudly. The old woman, by this cracking, had no difficulty in recognising him. On the morrow, the head of the municipal authority came to make his report to the king. 'Sire, there has been duelling this night, in such and such a street. One of the combatants is dead.' 'Have you discovered the murderer?' 'Yes, sire.' 'Why is he not already punished?' 'Sire, I await your orders.' 'Execute the law.' Now the king had just published a decree to the effect that every duellist should be beheaded, and that his head should be left exposed on the place of combat. The magistrate managed the business like an intelligent man; he had the head of a statue of the king cut off, and exposed it in a niche in the middle of the street, the scene of the murder.

II. GRAMMATICAL QUESTIONS:—

(*Not more than* seven *of the following questions are to be answered.*)

1. (*a*) Give the gender of:

cause, fem., Latin causa; *ligne*, fem., Lat. linea.
harmonie, fem., Lat. harmonia (orig. Gk. ἁρμονία.)
compliment, masc., Lat. complementum.
exclamation, fem., Lat. exclamatio.
majesté, fem., Lat. majestas; *peine*, fem., Lat. pœna.
épée, fem., probably because of its form, though Latin spadus is masc.
duel, masc., Lat. duellum; *affaire*, fem.
esprit, masc., Lat. spiritus; *théâtre*, masc., Lat. theatrum.
taille, fem.; *mort*, fem., Lat. mors.
heure, fem., Lat. hora; *ordre*, masc., Lat. ordo.
liberté, fem., Lat. libertas.

(*b*) Turn into French:

Her Majesty Queen Victoria. Sa Majesté la reine Victorie.
His Majesty the Emperor of Russia. Sa Majesté l'Empereur de la Russie.

2. (*a*) Form the plural of:

nez, nez; *fois*, fois; *bourreau*, bourreaux.
loi, lois; *lieu*, lieux.
Give the singular of:
yeux, œil.

(*b*) Give the feminine substantives corresponding to:

Empereur, Impératrice; *Sire*, Madame.
Mari, épouse; *Prisonnier*, prisonnière.
Distinguish between un voile and une voile.
un voile is a veil, cover, disguise.
une voile, a sail.

Distinguish between the English 'habit' and the French *habit*. The French word means coat, dress, clothes; the English usually means manners, custom, and corresponds more to the French *habitude*. In the phrase *riding-habit*, however, and often simply, the English word means much the same as the French, as is shown by Erskine's witticism that the 'new Speaker was adopting the abandoned habits of his predecessor.'

3. (*a*) Give the substantives corresponding to the verbs *sait, extraire, ouvrir, déplu, témoigna, répondit, cru, dû, sortir, arriva, surpris, découvert.*

Most of these verbs have both an abstract and a concrete noun corresponding; thus—

sait corresponds with *savant*, a philosopher, *savoir*, talent, and *sapience*, wisdom.
extraire with *extraction*, and *extrait*, an extract.
ouvrir with *ouverture*, opening, and *ouvreur*, an opener.
déplu with *déplaisance*, dislike.
témoigna with *témoin*, a witness, and *témoignage*, testimony.
répondit with *réponse*, reply, *répons*, response (church), and *répondant*, bailsman, bail.
cru with *croyance*, belief, and *croyant*, believer.
dû with *devoir*, duty, *dû*, Eng. due.
sortir with *sort*, fate, *sortants*, persons leaving a place, *sortie*, exit, sally.
arriva with *arrivée*, arrival, *arrivage*, touching port (of ships).
surpris with *surprise*, surprise.
découvert with *découverte*, discovery, *découvreur*, discoverer, *découvert*, deficit.

(*b*) Give the verbs corresponding to the substantives *cause, blessure, chagrin, attaque, querelle, bruit, rapport, décret, combat.*

cause, causer.
blessure, blesser.
chagrin, chagriner.
attaque, attaquer.
querelle, quereller.
bruit, bruire.
rapport, rapporter.
décret, décerner, décréter.
combat, combattre.

4. (*a*) Give the masculine (singular and plural) of:

funeste, funeste, funestes.
de laquelle, duquel, desquels.
cette, ce, ces.
elle-même, lui-même, eux-mêmes.
belle, beau or bel, beaux.
mauvaise, mauvais, mauvais.
première, premier, premiers.
dure, dur, durs.
vive, vif, vifs.
pauvre, pauvre, pauvres.
malheureuse, malheureux, malheureux.
vieille, vieux or vieil, vieux.
municipale, municipal, municipaux.
telle, tel, tels.
toute, tout, tous.

(*b*) Give the feminine singular of:
laid, laide; *celui*, celle; *dernier*, dernière;
cruel, cruelle; *amoureux*, amoureuse; *leste*, lestes;
singulier, singulière.

(*c*) When must you use the old forms *bel* and *vieil*? Give three examples.

Bel and *vieil* are masculine forms, originally interchangeable with beau and vieux, but later only used before a vowel or *h* mute. 'Un *bel* homme,' not 'un beau homme;' 'un vieil avocat,' 'un vieil attachement,' 'un bel entretien.'

But vieux is used, never vieil, if the noun with which it agrees precedes the adjective.

5. *Le* 16 *mars* 1716. (*a*) *Why not* 16 *ème* (*seizième*)?

The rule in such cases is, that all numbers except 'the first' must be expressed in French by the corresponding cardinals. So too, 'Henri Quatre,' but 'Richard le Premier.' Charles Quint,' 'Sixte Quint,' are exceptions.

Write in French, in two different ways, the date 1716.
Dix-sept cent seize. Mille sept cent et seize.

Turn into French:
'My brother will be fifteen years old on the 21st of June.'
Mon frère aura quinze ans le 21 (vingt et un) juin.
'To-day is the 14th.' Aujourd'hui c'est le 14 (quatorze).

(*b*) Give in French the names of the months of the year.

Janvier, février, mars, avril, mai, juin, juillet, août, septembre, octobre, novembre, décembre.

6. Give the pres. and past participles, and the 1st pers. sing. of the future of:

sait, sachant, su, je saurai.
reçut, recevant, reçu, je recevrai.
extraire, extrayant, extrait, j'extrairai.
ouvrir, ouvrant, ouvert, j'ouvrirai.
déranger, dérangeant, dérangé, je dérangerai.
devait, devant, dû, je devrai.
périr, périssant, péri, je périrai.
sortir (law term, to obtain), sortissant, sorti, je sortirai.
sortir (to go on), sortant, sorti, je sortirai.
disparut, disparaissant, disparu, je disparaîtrai.
envoya, envoyant, envoyé, j'enverrai.
rejoindre, rejoignant, rejoint, je rejoindrai.
appelait, appelant, appelé, j'appellerai.
pris, prenant, pris, je prendrai.
tenait, tenant, tenu, je tiendrai.
vint, venant, venu, je viendrai.

7. (*a*) Conjugate the imperative of *sait, fut, reçut, dit, fil, sortir, envoya, alla, mit, mort.*

sait	sache	*fut*	sois	*reçut*	reçois	*dit*	dis
	sachons		soyons		recevons		disons
	sachez		soyez		recevez		dites
fil	fais	*sortir*	sors	*envoya*	envoie	*alla*	va
	faisons		sortons		envoyons		allons
	faites		sortez		envoyez		allez
		mit	mets	*mort*	meurs		
			mettons		mourons		
			mettez		mourez		

(*b*) Give infin. pres. and 1st pers. sing. of subj. (pres. and impf.) of:—

déplu	déplaire	je déplaise	je déplusse
cru	croire	je croie	je crusse
dû	devoir	je doive	je dusse
permis	permettre	je permette	je permisse
surpris	surprendre	je surprenne	je surprisse
battit	battre	je batte	je battisse
mort	mourir	je meure	je mourusse
découvert	découvrir	je découvre	je découvrisse

8. (*a*) Conjugate negatively indic. plupf. of *se sauva* s'écriant, alla:

je ne m'étais pas sauvé.
tu ne t'étais pas sauvé.
il ne s'était pas sauvé. / elle ne s'était pas sauvée.
nous ne nous étions pas sauvés.
vous ne vous étiez pas sauvés.
ils ne s'étaient pas sauvés. / elles ne s'étaient pas sauvées.
je ne m'étais pas écrié.
tu ne t'étais pas écrié.
il ne s' était pas écrié. / elle ne s'était pas écriée.
nous ne nous étions pas écriés.
vous ne vous étiez pas écriés.
ils ne s'étaient pas écriés.
elles ne s'étaient pas écriées.

je ne n'étais pas allé.
tu ne n'étais pas allé.
il ne n'était pas allé. / elle n'était pas allée.
nous n'étions pas allés.
vous n'étiez pas allés.
ils n'étaient pas allés. / elles n'étaient pas allées.

(*b*) The subj. pres. of se promener, se tenait, se battit.

je ne me promène pas.
tu ne te promènes pas.
il ne se promène pas.
nous ne nous promenions pas.
vous ne vous promeniez pas.
ils ne se promènent pas.
je ne me batte pas.
tu ne te battes pas.
il ne se batte pas.
nous ne nous battions pas.
vous ne vous battiez pas.
ils ne se battent pas.

je ne me tienne pas.
tu ne te tiennes pas.
il ne se tienne pas.
nous ne nous tenions pas.
vous ne vous teniez pas.
ils ne se tiennent pas.

(*c*) Give the past part., fut., and subj. pres. of *faut* fallu, il faudra, qu'il faille.

9. (*a*) Distinguish between *attendre* and *to attend.*

Attendre means to wait for, tarry for. *To attend* means usually to *wait upon*, though sometimes (especially in poetry) it has the French meaning. We say in French, 'Le dîner nous *attend*,' the dinner is waiting for us; in English, 'The waiter *attends* upon us.'

(*b*) Give the first person singular of the indic. pres. (conjugated interrogatively) of :

reçut, reçois-je ?	*cru*, crois-je ?
rendu, rends-je ?	*devait*, dois-je ?
pleura, pleurs-je ?	*permis*, permets-je ?
sortir, sors-je ?	*mènerait*, mené-je ?
alla, vais-je ?	*prit*, prends-je ?
tenait, tiens-je ?	*attends*, attends-je ?

10. Put in the plural :

(*a*) C'était une capitulation.
C' étaient des capitulations.

(*b*) Comme cette blessure t'a rendu laid !
Comme ces blessures t'ont rendu laid !

(*c*) Il se sauva par la tendresse ingénieuse de son épouse.
Ils se sauvaient par la tendresse ingénieuse de leurs épouses.

(*d*) Me voilà sauvé !
Mons voilà sauvés !

(*e*) Une vieille femme mit la tête à la fenêtre, et éclaira la scène avec la petite lampe qu'elle tenait à la main.
De vieilles femmes mirent les têtes aux fenêtres et éclairaient la scène avec les petites lampes qu'elles tenaient aux mains.

(*f*) Pourquoi n'est-il pas déjà puni ?
Pourquoi ne sont-ils pas déjà punis ?

Greek.

II.—XENOPHON, ANABASIS, BOOK II.

A.

Translate—

Ἐπεὶ δὲ ἐδόκει καιρὸς εἶναι, ἀπήγγελλεν ὅτι σπένδοιτο, καὶ εὐθὺς ἡγεῖσθαι ἐκέλευε πρὸς τὰ παρασκευάσια. καὶ οἱ μὲν ἠγοῦντο, Κλέαρχος μέντοι ἐπορεύετο τὰς μὲν σπονδὰς ποιησάμενος, τὸ δὲ στράτευμα ἔχων ἐν τάξει, καὶ αὐτὸς ὠπισθοφυλάκει καὶ ἐνετύγχανον τάφροις καὶ αὐλῶσιν ὕδατος πλήρεσιν ὡς μὴ δύνασθαι διαβαίνειν ἄνευ γεφυρῶν. ἀλλ' ἐποιοῦντο ἐκ τῶν φοινίκων οἳ ἦσαν ἐκπεπτωκότες, τοὺς δὲ καὶ ἐξέκοπτον. καὶ ἐνταῦθα ἦν Κλέαρχον καταμαθεῖν ὡς ἐπεστάτει, ἐν μὲν τῇ ἀριστερᾷ χειρὶ τὸ ὄόρυ ἔχων, ἐν δὲ τῇ δεξιᾷ βακτηρίαν. καὶ εἴ τις αὐτῷ δοκοίη τῶν πρὸς τοῦτο τεταγμένων βλακεύειν, ἐκλεγόμενος τὸν ἐπιτήδειον ἔπαισεν ἄν, καὶ ἅμα αὐτὸς προσελάμβανεν εἰς τὸν πηλὸν ἐμβαίνων. ὥστε πᾶσιν αἰσχύνην εἶναι μὴ οὐ συσπουδάζειν· καὶ ἐτάχθησαν μὲν πρὸς αὐτοῦ οἱ τριάκοντα ἔτη γεγονότες. ἐπεὶ δὲ καὶ Κλέαρχον ὥρων σπουδάζοντα, προσελάμβανον καὶ οἱ πρεσβύτεροι.

And when the time seemed to have arrived, he announced that he agreed to the treaty, and bade them immediately lead the way to the provisions. They then led on, but Clearchus, though he had made the treaty, marched with his army in full order, and himself commanded the rear-guard. And they came upon trenches and canals full of water, so that one could not cross them without bridges ; but they made them of palm-trees which had fallen, and others besides they cut down. And then one could see how Clearchus commanded, with his spear in his left hand and a rod in his right. And if any of the men set apart for this work seemed to him to be idling, he would pick out the proper person and chastise him ; and at the same time he himself shared in the work, and went down into the mud ; so that all were ashamed not to co-operate. And those who were thirty years of age were appointed by him (to this work), but when they saw Clearchus also zealously working, those who were older took part in the toil.

B.

Ἐπεὶ δὲ μεταγνόντες πως οἱ ἔφοροι ἤδη ἔξω ὄντος ἀποστρέφειν αὐτὸν ἐπειρῶντο ἐξ Ἰσθμοῦ, ἐνταῦθα οὐκέτι πείθεται, ἀλλ' ᾤχετο πλέων εἰς Ἑλλήσποντον. ἐκ τούτου καὶ ἐθανατώθη ὑπὸ τῶν ἐν τῇ Σπάρτῃ τελῶν ὡς ἀπειθῶν. ἤδη δὲ φυγὰς ὢν ἔρχεται πρὸς Κῦρον, καὶ ὁποίοις μὲν λόγοις ἔπεισε Κῦρον ἄλλῃ γένραπται, εἰκῶσι δὲ αὐτῷ μυρίους δαρεικούς. ὁ δὲ λαβὼν οὐκ ἐπὶ ῥᾳθυμίαν ἐτράπετο, ἀλλ' ἀπὸ τούτων τῶν χρημάτων συλλέξας στράτευμα ἐπολέμει τοῖς Θρᾳξί, καὶ μάχῃ τε ἐνίκησε, καὶ ἀπὸ τούτου δὴ ἔφερε καὶ ἦγε τούτους καὶ πολεμῶν διεγένετο μέχρι Κῦρος ἐδεήθη τοῦ στρατεύματος. τότε δὲ ἀπῆλθεν ὡς σὺν ἐκείνῳ αὖ πολεμήσων.

And when the Ephors, when he was now out of the country, repented and tried to turn him away from the Isthmus, then he ceased to obey them, but departed by sea to the Hellespont. For this he was condemned to death by the magistrates in Sparta as contumacious. Being now an exile he comes to Cyrus. The kind of arguments by which he persuaded Cyrus has been related elsewhere. And Cyrus gave him ten thousand darics. On receiving them he did not give himself over to ease, but got an army together with this sum and made war on the Thracians, and not only overcame them in battle but after that wasted and harried their territory and continued in war until Cyrus wanted the army ; and then he departed, with the intention of again carrying on war in company with him.

II.—Grammar.

1. Decline *throughout* οὗτος ὁ ἀνὴρ, ἡ ἀληθὴς δόξα : in the *singular* γλυκὺς φοίνιξ ; in the *plural* μέγας βασιλεύς, οἰκέτις γυνή.

οὗτος	ὁ	ἀνήρ.	ἡ	ἀληθὴς	δόξα.
τοῦτον	τὸν	ἄνδρα.	τὴν	ἀληθέα-η	δόξαν.
τούτου	τοῦ	ἀνδρὸς.	τῆς	ἀληθοῦς	δόξας.
τούτῳ	τῷ	ἀνδρί.	τῇ	ἀληθεῖ	δόξᾳ.
τούτω	τὼ	ἄνδρε.	τὰ	ἀλήθεε	δόξα.
τούτοιν	τοῖν	ἀνδροῖν.	ταῖν	ἀληθέοιν	δόξαιν.
οὗτοι	οἱ	ἄνδρες.	αἱ	ἀληθεῖς	δόξαι.
τούτους	τοὺς	ἄνδρας.	τὰς	ἀληθέας-εις	δόξας.
τούτων	τῶν	ἀνδρῶν.	τῶν	ἀληθέων-ων	δοξων.
τούτοις	τοῖς	ἀνδράσι.	ταῖς	ἀλήθεσι	δόξαις.

γλυκὺς φοῖνιξ.
γλυκὺν φοίνικα.
γλυκέος φοίνικος.
γλυκεῖ φοίνικι.

μέγαλοι βασιλεῖς (βασιλῆς; βασίλεες.)
μεγάλους βασιλέας.
μεγάλων βασιλέων.
μεγάλοις βασίλευσι.

οἰκέτιδες γυναῖκες.
οἰκετίδας γυναῖκας.
οἰκετίδων γυναικῶν.
οἰκετισι γύναιξι.

2. Give the genitive singular and dative plural of δράκων, ἄστυ, ἀστήρ, ἰχθύς, λέως, παῖς, χείρ, τεῖχος ; also of μείζων, πᾶς.

δράκων,	δράκοντος,	δράκουσι.
ἄστυ,	ἄστεος (εως),	ἄστεσι.
ἀστήρ,	ἀστέρος,	ἄστρασι.
ἰχθύς,	ἰχθύος,	ἴχθυσι.
λεώς,	λεώ,	λεῴς.
παῖς,	παιδὸς,	παισί.
χείρ,	χειρός,	χερσί.
τεῖχος,	τείχεος-ους,	τείχεσι.
μείζων,	μείζονος,	μείζοσι.

πᾶς, παντός, πάσης, παντός, πᾶσι, πάσαις, πᾶσι.

3. Give the comparative and superlative of—

παλαιός,	παλαιώτερος } παλαίτερος }	παλαιώτατος } παλαίτατος }
κενός,	κενότερος } κενώτερος }	κενότατος } κενώτατος }
λάλος,	λαλίστερος,	λαλίστατος.
μέλας,	μελάντερος,	(μελάνταος.)
εὐσεβής,	εὐσεβέστερος,	εὐσεβέστατος.
σώφρων,	σωφρονέστερος,	σωφρονέστατος.
ταχύς,	θάσσων (ταχίων) (ταχύτερος)	τάχιστος.
ἄνω,	ἀνωτέρω,	ἀνωτάτω.
κακῶς,	κάκιον,	κάκιστα.
μάλα,	μᾶλλον,	μάλιστα.

4. Parse fully—

ἁλισθῇ. 3rd person singular, 1st aorist, subjunctive, passive of ἁλίζω, ἁλίσω, ἡλίσθην, ἥλισμαι.

διέσπαρθαι. Perfect infinitive, passive of διασπείρω, -σπερω, -εσπειρα, εσπαρμαι.

ἐξεπλάγη. 3rd person singular, 2nd aorist, indicative, passive of ἐκπλήσσω, πλήξω, ἐξέπληξα, ἐξεπλάγην, ἐκπέπληγμαι.

λελείψεται. 3rd person singular, future-perfect, indicative, passive of λείπω, λείψω, λέλοιπα, ἔλιπον.

ἐλεγχθῶσι. 3rd person plural, 1st aorist, subjunctive, passive of ἐλέγχω, ἐλεγξω, ἤλεγξα.

ἀφεικέναι. Perfect infinitive, active of ἀφίημι, ἀφήσω, ἀφεῖκα (perfect), ἀφῆκα (aorist).

ᾐσχύνθημεν. 1st person plural, 1st aorist, indicative, passive of αἰσχύνω, αἰσχυνῶ, ᾔσχυνα.

κατετέτμητο. 3rd person singular, pluperfect, indicative, passive of κατατέμνω, κατατεμῶ, κατέταμον, κατατέτμηκα.

ἐχρῆτο. 3rd person singular, imperfect, indicative (mid.) of χράομαι, χρήσομαι, ἐχρησάμην.

ἀποδραίη. 3rd person singular, 2nd aorist, opt., act. of ἀποδιδράσκω, δράσομαι, δέδρακα, ἀπέδραν.

5. Write out all the (Attic) forms of the present and aorist indicative, active of τίθημι *or* δίδωμι; also the present, subjunctive, active of μισθόω.

Present.	τίθημι,	τίθετον,	τίθεμεν.
	τίθης,	τίθετον,	τίθετε.
	τίθησι,		(τιθέασι) τιθεῖσι.
Aorist.	ἔθηκα,	(ἔθετον),	ἔθεμεν.
	ἔθηκας,	(ἐθέτην),	ἔθετε.
	ἔθηκε,		ἔθεσαν or ἔθηκαν.

μισθῶ	(μισθόω),	μισθῶτον (μισθοητον, etc.),	μισθῶμεν.
μισθοῖς	(μισθόῃς),	μισθῶτον,	μισθῶτε.
μισθοῖ	(μισθόῃ),		μισθῶσι.

6. Give the exact import of the *preposition* in the following words and phrases—

διῆγον. Here the preposition has the force of 'completely,' 'through to the end.' διάγειν βίον, is to pass life.

ἀντάκουσον. ἀντί, here means *in turn*, or *in return*. 'Hear in return'; cf. ἀντιβοηθέω, to assist mutually, cf. ἀντεράω.

ἐπιβουλεύειν. To plot *against*, ἐπί, in composition, denoting motion towards, especially in a hostile sense.

ἀπαιτεῖ. 'Demands *back*'; cf. ἀποδίδωμι, to give back.

περιγενέσθαι. In this and other words, as, περίειμι, περιεργάζομαι, περί seems to have the meaning of excess; a going beyond. 'To survive' or 'to overcome.'

κατεγέλα. Here the preposition has a contemptuous sense; 'laughed to scorn'; perhaps connected with the 'hostile' sense found in κατηγορέω.

παρὰ πότον ἡδὺν = during drinking. παρά with accusative properly denotes motion to the side of, or motion along. From this latter sense is derived its use in such phrases as the present—where it denotes a parallelism between the sweetness and the drinking, so sweet while it is being drunk.

Explain the force of ἄν in ἔπαισεν ἄν (Extract A.)

The use of ἄν with a verb implies that the action denoted by the verb would take place, if certain conditions occur. Where these conditions are represented as really occurring, and it is wished to denote that the ensuing action really depends upon their occurrence, the indicative is used to show that the results really happen, with ἄν to show that they were conditional. The indicative with ἄν thus comes to be used especially as here after an optative of indefinite frequency with a sort of frequentative sense, the imperfect referring to continued acts, the aorist to momentary.

7. Put into Greek—

Do not ye think?	ἆρ' οὐκ οἴεσθε;
More evils.	πλειόνα κακῶν.
Clever at speaking.	δεινὸς λέγειν.

The messenger came into the harbour.

ὁ ἄγγελος εἰσῆλθεν εἰς τὸν λιμένα.

III.

1. Enumerate and classify the extant works of Xenophon. Why have doubts been expressed whether he was really the author of the Anabasis?

A. Historical: 1. Hellenica, a continuation of Thucydides' History of Peloponnesian War. 2. Anabasis.

B. Political Works: 1. Cyropædia (monarchial romance). 2. Panegyric on Agesilaus, King of Sparta. 3. Respublica Lacedæmoniorum. 4. Respublica Atheniensium—both doubtful. [5. Περὶ προσόδων —certainly not by Xenophon.]

C. Socratic and Philosophical: 1. Memorabilia. 2. Apology of Socrates. 3. Symposium. 4. Oeconomicus. 5. Hiero.

D. Horses and Dogs: 1. Hipparchicus (A cavalry leader's manual). 2. Ἱππική. 3. Κυνηγετικός.

In Xenophon's Hellenics (III. 1, 2), when referring to the retreat of the Ten Thousand, he refers his readers to the history of that retreat, as having been written by Themistogenes of Syracuse. Accordingly it has been suggested by some that the Anabasis we have was written not by Xenophon but by this Themistogenes. But it seems more probable that Xenophon, perhaps being unwilling to offend either Sparta or Athens by the sentiments contained in the Anabasis, resorted to the device of attributing its authorship to some imaginary Syracusan. Or his own may not have then been written.

2. What was the political state of Greece which gave rise to the connection of Persia, particularly of Cyrus, with Lacedæmon at the time of this expedition? How came Xenophon to be one of the commanders?

The Greek cities on the coast of Asia Minor were nominally tributary to the Great King even after the Persian War. But during the naval supremacy of Athens, the tribute of course could not be exacted. When however the King heard of the annihilation of the Sicilian Expedition, he sent to demand from his Asiatic Satraps this additional amount. After long negotiations, Tissaphernes, one of the Satraps, makes an alliance with the Peloponnesians against Athens. But finding that Athens quickly recovered, he endeavours to wear both parties out by intrigues and leaving them to decide their war alone. But King Darius sends down his younger son Cyrus as Governor of most of Asia Minor. He was filled with hatred to Athens, and when the Spartan Lysander visited him at Sardis furnished him with large sums of money for naval operations against her. Two years later, Cyrus was called to Susa to the death-bed of his father, and left all the tribute of his provinces under Lysander's control. By this help, Lysander was enabled to overthrow Athens.

Xenophon received a letter from his friend Proxenus urging on him the advantages to be gained by entering the service of Cyrus. After asking advice of Socrates and consulting the oracle of Delphi, he joined Cyrus as a volunteer. After the

murder of Proxenus and the other generals, encouraged by a dream, he called together the captains who had served under Proxenus, dwelt on their grounds for hope, and urged them to set an example to the rest of cheerful activity. Accordingly they convened all the captains and, at the request of the senior of Proxenus' captains, Xenophon repeated to them his advice and urged them to select generals to take the places of the dead, and appeal to the army to confirm their action. Xenophon was chosen to succeed Proxenus. The army, after speeches by the new generals, confirmed the appointments and promised obedience.

3. ἐπ' Αἰγυπτον στρατεύειν (I. 14); What were the relations between Persia and Egypt at the time of the Anabasis? By which of the Persian Kings was Egypt first brought into subjection, and who was its King at the time?

At the time of the Anabasis Egypt was in revolt against Persia. During the war between Persia and Greece, about 460, Amyrtaeus had proclaimed himself King, but had been subdued and driven into the marshlands of the Nile. In 414, however, he drove the Persians out of Egypt and maintained his position till 408, when he died and was succeeded by his son Pausiris, who in turn was succeeded by Acoris.

This was a dynasty of native Egyptian Kings, who through the natural strength of the country, and the support from time to time of Greek states at war with Persia, and revolted Satraps, were able to resist the ceaseless attempts of the Persian Kings to reduce them.

Egypt was first conquered by the Persians under Cambyses in 525. At that time its king was Psammenitus, his great father Amasis having died while Cambyses was making his preparations.

4. Give some account of the Gorgias mentioned in this Book.

Gorgias was born at Leontini about 480 B.C. In 427, he was sent as ambassador to Athens to ask for aid against Syracuse. Very shortly after he seems to have left Leontini and come once more to Greece. Here he lived till his death, carrying on his profession of rhetoric, of which he was the first recognised and paid master at Athens. Most of the Athenian orators of the time were amongst his pupils. He professed to teach how to speak on any given subject. His style was artificial, and too poetical. He addressed a 'Panegyricus' to the Greeks assembled at the Olympic Games in 392 B.C. He is said to have died at the age of 108.

5. Describe the course of the Euphrates and the countries through which it flows. When did the name Mesopotamia first come into use? What is its scriptural name?

The Euphrates rises in the mountains of Armenia and flows at first in a south-westerly direction, forming after a while the border-line between Armenia and Cappadocia, then with various bends it holds almost a southerly course, till, as the boundary between Syria and Mesopotamia, it turns to the south-east and finally, receiving the Tigris, flows into the Persian Gulf.

Flowing through the mountainous country of Armenia, it divided it into Armenia Major and Armenia Minor. The former extended from the Euphrates to the Caspian, and comprised the Ararat range and the valley of the Araxes; the latter was bounded by Cappadocia and Pontus.

Cappadocia lay between the Taurus and Pontus, and was bounded on the west by the Halys and on the east by Lesser Armenia and the Euphrates.

After leaving Armenia, the Euphrates divided Commagene from Mesopotamia. Commagene was a small region lying around Samosata, cut off from Armenia and Mesopotamia by the Euphrates, and from Cappadocia by Mt. Taurus.

South of Commagene lay Syria, along the N.E. border of which the Euphrates flowed. It was the rich region stretching from the Syrian Desert to the Great Sea and lying along the whole eastern shore of that sea. Amongst its famous cities were Antioch, Damascus, Tyre, Caesarea, Jerusalem and Palmyra.

Mesopotamia, in its wider and improper sense, comprised the whole district of the plain of the Euphrates and Tigris. More accurately it was only the northern portion of the district between these two rivers, being divided from Assyria by the Tigris on the east, and from Babylonia by the Median Wall in the south. Its chief towns were Edessa and Nisibis, with Cunaxa on the Euphrates in the extreme south. Thence the Euphrates flows through Babylonia past Babylon to join the Tigris.

The name Mesopotamia was first given to the region in the time of the successors of Alexander, when the Asiatic conquests of that king were formed by Seleucus into the kingdom of Syria.

Its scriptural name in the proper sense is 'Aram Naharaim,' 'Syria of the Rivers.' In the earlier books the name Padan Aram is used rather more loosely.

IV.—Passages for translation from books not prescribed—

1. Λεγειν δέ ποτε κωλυόμενος ὑπ' Ἀθηναίων ἐν ἐκκλησίᾳ Δημοσθένης βραχὺ ἔφη βούλεσθαι πρὸς αὐτοὺς εἰπεῖν. τῶν δὲ σιωπησάντων 'Νεανίας,' εἶπε, 'θέρους ὥρᾳ ἐμισθώσατο ἐξ ἄστεος ὄνον Μεγάραδε. μεσούσης δὲ τῆς ἡμέρας καὶ σφοδρῶς φλέγοντος τοῦ ἡλίου, ἑκάτερος αὐτῶν ἐβούλετο ὑποδύεσθαι ὑπὸ τὴν σκίαν. εἴργον δ' ἀλλήλους, ὁ μὲν μεμισθωκέναι τὸν ὄνον, οὐ τὴν σκιάν, λέγων. ὁ δὲ μεμισθώμένος τὴν πᾶσαν ἔχειν ἐξουσίαν.' καὶ ταῦτ' εἰπὼν ἀπῆει.

Once, when Demosthenes was hindered from speaking by the Athenians in the Assembly, he said he should like to speak shortly to them, and when they were silent he said:—'A young man in summer-time hired an ass from the city to go to Megara. When it was mid-day and the sun was exceedingly hot, each of them wanted to retreat under the shade. But they prevented one another, the one saying he had hired out the ass but not the shadow, and the man who had hired it saying he had complete control over it.' And when he had said this, he departed.

2. ὁρῶν ὁ Σωκράτης τὸν Ἀλκιβιάδην μέγα φρονοῦντα ἐπὶ τῷ πλούτῳ καὶ τοῖς ἀγροῖς ἤγαγεν αὐτὸν εἰς τινα τῆς πόλεως τόπον, ἔνθα ἀνέκειτο πινάκιον ἔχον γῆς περίοδον καὶ προσέταξε τῷ Ἀλκιβιάδῃ τὴν Ἀττικὴν ἐνταῦθα ἀναζητεῖν. ὡς δ' εὗρε, προσέταξεν αὐτῷ τοὺς ἀγροὺς τοὺς ἰδίους διαθρῆσαι. τοῦ δὲ εἰπόντος 'ἀλλ' οὐδαμοῦ γεγράμμενοι εἰσὶν' 'ἐπὶ τούτοις οὖν' εἶπε 'μέγα φρονεῖς, οἵπερ οὐδὲν μέρος τῆς γῆς εἰσίν;'

Socrates, seeing Alcibiades greatly pluming himself on his wealth and estates, brought him to a place in the city where was fixed a tablet containing a map of the world, and bade Alcibiades seek out Attica on it. And when he had found it, he bade him discover his own estates. When he said 'But they aren't marked anywhere,' he said, 'Is it on these then that you plume yourself, which are not even a part of the world?'

3. φιλεῖ καὶ πᾶσι στρατοπέδοις, μάλιστα δὲ τοῖς μεγίστοις, φόβοι καὶ δείματα ἐγγίγνεσθαι, ἄλλως τε καὶ ἐν νυκτί τε καὶ διὰ πολεμίας καὶ ἀπὸ πολεμίων οὐ πόλὺ ἀπεχόντων ἰοῦσιν.

All armies, and especially those which are very large, are liable to panics and terrors, especially when marching by night, and through an enemy's country, and at no great distance from their enemies. (The constr. varies in the last clause; literally, 'away from enemies who are not far distant.')

Latin.

[Time, TWO HOURS.]

I.—VIRGIL. GEORGICS II. AND AENEID XII.

A.

Translate into English—

At quæ pinguis humus dulcique uligine laeta,
quique frequens herbis et fertilis ubere campus,—
qualem saepe cava montis convalle solemus
dispicere—huc summis liquuntur rupibus amnes
felicemque trahunt limum—quique editus austro,
et filicem curvis invisam pascit aratris:
hic tibi prævalidas olim multoque fluentis
sufficiet Baccho vitis, hic fertilis uvæ,
hic laticis, qualem pateris libamus et auro,
inflavit cum pinguis ebur Tyrrhenus ad aras,
lancibus et pandis fumantia reddimus exta.

But a soil which is rich and luxuriant with fresh moisture, and a plain which is crowded with herbage and teeming with richness,

such as we are often wont to see beneath us in some hollow mountain-dell—
into it pour down streams from the tops of the rocks,
and draw down with them fertilising slime—
a plain that rises to the south
and nourishes fern, that enemy to curved ploughs:
this land will one day bear you sturdy vines, yielding rivers of Bacchic juice:
this land will be teeming with grapes and with liquor such as we pour in libations from cups of gold
when the plump Etruscan at the altar has blown through the ivory pipe,
and we offer in bending dishes entrails smoking hot.

B.

Ut primum discussæ umbræ, et lux reddita menti,
ardentis oculorum orbes ad mœnia torsit,
turbidus, eque rotis magnam respexit ad urbem.
ecce autem flammis inter tabulata volutus
ad cælum undabat vertex turrimque tenebat,
turrim, compactis trabibus quam eduxerat ipse,
subdideratque rotas pontisque instraverat altos.
'jam jam fata, soror, superant; absiste morari;
quo deus et quo dura vocat Fortuna, sequamur.
stat conferre manum Aeneae, stat quid quid acerbi est
morte pati; neque me indecorem, germane, videbis
amplius. Hunc, oro, sine me furere ante furorem.'

Soon as the shadows parted and light was restored to his mind
he darted towards the ramparts the blazing balls of his eyes,
distraught, and from his car looked back upon the wide-spreading city.
And lo—as the flames spread in folds from story to story
their top flared to heaven and devoured the turret,
the turret which he himself had reared of planks fixed together,
putting wheels beneath it and laying on it lofty bridges.
'At length, at length, my sister, do the Fates prevail—cease to stay me—
Whither Heaven and cruel Fortune call me, let me go.
I am resolved to meet Aeneas hand to hand; I am resolved to bear
whate'er in death is bitter; and no longer, sister mine,
shalt thou see me disgraced; suffer me first, I beg, to give my madness play.'

C.

Tum pectore sensus
vertuntur varii. Rutulos adspectat et urbem
cunctaturque metu, telumque instare tremescit;
nec quo se eripiat, nec qua vi tendat in hostem.
cunctanti telum Aeneas fatale coruscat
sortitus fortunam oculis, et corpore toto
eminus intorquet. murali concita nunquam
tormento sic saxa fremunt, nec fulmine tanti
dissultant crepitus. volat atri turbinis instar
exitium dirum hasta ferens orasque recludit
loricæ et clipei extremos septemplicis orbes.

Then confused feelings whirl through his heart; he looks to his Rutulians and to his city, and falters with dread, and shudders, thinking that the spear is upon him.
Nor knows he whither to escape, nor by what power to front the foe,
[nor sees he anywhere his chariot, and his sister driving it].
Before his shrinking foe Aeneas shakes his fate-fraught spear,
taking correct aim with his eyes, and straining his whole frame hurls it forth.
Never do stones flung from engine of siege roar so loud,
nor peals so mighty leap forth with the lightning.
Like a dark whirlwind flies the spear, fraught with fell death,
and pierces the edge of the corselet, and the outermost rim of the seven-fold shield.

II.—HISTORY AND GEOGRAPHY.

1. Write down the date and place of Virgil's birth and death, and the titles of his works.

He was born at Mantua, B.C. 70, and died at Brundisium, B.C. 19.

His chief works are the ten Eclogues or Bucolics, the four Books of Georgics, and the twelve of the Aeneid. Besides these he wrote several smaller works, such as the Copa, the Culex, the Moretum; but the authorship of the Copa and Culex has been disputed.

The Ciris and Aetna have also been attributed to him, but in all probability wrongly. Other short pieces, called Catalecta, are also included in his works.

2. Tell what you know about Maecenas, C. Cornelius Gallus, Asinius Pollio, Varius, and Tucca; and state how each was connected with the life of Virgil.

Cilnius Maecenas belonged to an old Etruscan family and was born about the year 70 B.C. When the young Octavian became prominent, Maecenas attached himself to him. During the quarrels of Octavian and Antony, he acted as the ambassador of the former. After the battle of Actium in 31 B.C., he was the chief civil minister of Augustus until B.C. 16, when, falling into disfavour, he retired into private life. He died B.C. 8.

It was through his offices that Virgil recovered his confiscated farm in 41 B.C., and it was at his request that Virgil wrote the Georgics. He wrote some poor verse himself, but the care he showed for the poets of the age has made his name a synonym for a patron of literature.

Gallus was born at Forum Julii in 69 B.C., and was the friend of Virgil's youth. Attaching himself to Octavian, he gained quick promotion. He was the first to introduce Virgil to the Triumvir. After Actium, he was made Prefect of Egypt, but was accused of treason and forbidden the presence of Augustus. He soon after committed suicide, B.C. 27. The Tenth Eclogue is a 'song to Gallus.' It is said that the end of Georgic IV., now occupied with the story of Orpheus and Eurydice, was originally devoted to a lament for Gallus, which Augustus bade Virgil remove. He was a poet of some promise.

Pollio, born 76 B.C., early became known as an orator, took Cæsar's side against Pompey, and in 45 B.C. was made Governor of Further Spain. In 43 he joined Antony and Octavian. When the Triumvirate was formed, Antony made him Governor of Gaul. While settling the veterans, he confiscated Virgil's farm, B.C. 40, but restored it at the request of Maecenas. In B.C. 40 he was consul, and in this year Virgil addressed to him the Fourth Eclogue. In B.C. 39 he obtained a triumph for victories over the Dalmatians, and Virgil addressed to him the Eighth Eclogue. From this time, till his death in A.D. 4, he kept himself free from politics. He began a history of the times but found it impossible to finish it impartially, so abandoned it. He was recognised as a great orator and tragic dramatist. He founded the first library in Rome and was the first to publicly recite his compositions.

L. Varius Rufus—born in Gaul 64 B.C., died 9 A.D.—was a life-long friend of Virgil, whom, as well as Horace, he was the first to introduce to Maecenas. He wrote epics on the death of Cæsar, and the deeds of Augustus. From the former Virgil adapted three lines (Ecl. viii., 88, Aen. vi., 621, 622). After Virgil's pre-eminence as an epic poet was recognised, Varius turned to the drama. Quintilian pronounced his 'Thyestes' equal to any Greek play. Virgil appointed Varius and Tucca his executors. They revised and published the Aeneid, Varius apparently prefixing a biography of Virgil.

Plotius Tucca, a friend of Virgil, whom the poet named as one of his heirs. To Tucca and Varius he left his unfinished writings. At the bidding of Augustus, they published the Aeneid, instead of burning it as desired. He was also a friend of Horace.

3. Write a very short historical note on this passage:—

Decios, Marios, magnosque Camillos,
Scipiadas duros bello, et te, maxime Cæsar,
Qui nunc extremis Asiæ jam victor in oris
Inbellem avertis Romanis arcibus Indum.

Decii.—Two of the Decii, Plebeian Consuls, one in 340 B.C., the other in 295, devoted themselves and the hostile armies to destruction in battle to secure the victory of their armies, as a vision had declared that the side whose general died should be victorious.

Camillos.—Referring specially to M. Furius Camillus, five times Dictator, who conquered Veii in 396, and saved Rome from the Gauls in 390, and defeated them again 367. His son Lucius also defeated the Gauls in 349.

Scipiadas.—The two greatest Scipios are specially in Virgil's mind; P. Africanus, who defeated Hannibal at Jama in 202, and P. Aemilianus, who conquered Carthage in 146, and Numantia in 133.

Cæsar is Augustus. The war with Antony was often regarded as a war of the West with the East.

After defeating Antony at Actium, B.C. 31, Octavian pursued him to Egypt. After Antony's death and the annexation of Egypt he passed into Asia, where he received the allegiance of the countries that had supported Antony, and the submission of the remnants of his forces. Virgil, with poetic licence, exaggerates the importance of this conduct.

Marios.—Perhaps a poetical plural. The great Marius, who was seven times consul, was the conqueror of Jugurtha and the saviour of Italy by his victories over the Cimbrians and Teutons, 102 and 101. His son was, after his death, one of the leaders of the popular party in the Civil War against Sulla.

4. What is the meaning of Ascraeum carmen, of Ephyreia aera? Who was Orithyia?

Virgil calls his Georgics 'Ascraeum carmen,' 'song of Ascra,' in reference to the 'Works and Days' of Hesiod, a native of Ascra in Boeotia. This poem was the prototype of the Georgics, being a didactic poem on agriculture, composed in hexameters.

Ephyreia aera. 'Corinthian bronzes.' Ephyra was the original name of Corinth. Homer calls it 'wealthy Ephyre.' From 146 B.C. when its art-treasures were carried to Rome, its statues, &c., were famous. After Julius Cæsar re-founded it, Corinth was the Greek port for Rome. Its brass was always noted. The possession of Corinthian bronzes was naturally a sign of wealth and luxurious culture.

Orithyia, daughter of Erechtheus, king of Athens. Boreas carried her off to be his wife from the banks of the Ilissus.

5. Describe the position of the following:—

Benacus, now Lake Maggiore, at the foot of the Alps, north of Mantua, in Cisalpine Gaul.

Clitumnus, in Umbria, flows southward, and falls into the Tiber on its Eastern bank.

Cytorus, a sea port on the coast of Paphlagonia, near Sinope.

Haemus, the eastern part of the Balkan Mountains, lay along the north of Thrace.

Ismarus, a mountain and town in Thrace, near the north coast of the Aegaean Sea.

Methymna, a town on the north coast of Lesbos, in the east of the Aegaean.

Mareotis, a lake immediately to the south of Alexandria, at the north-west corner of the Delta of the Nile.

Paphos, a town at the extreme west of Cyprus.

Parnassus, a mountain-range in the centre of northern Greece, but in a more restricted sense it denotes the highest ridge in this range, just north of Delphi.

Spercheus, a river flowing through the south of Thessaly, into the Maliac Gulf, just north of Thermopylae.

Taygeta, mountain-range dividing the southern half of Peloponnesus equally. It ran from north to south in Laconia, parallel with the river Eurotas.

Tarentum, a town in South Italy, at the north-east corner of the Gulf of Tarentum, just at the commencement of the 'heel.'

III.—Passages for Translation from Books not prescribed.

A.

Nec enim tantum mali est peccare principes, quamquam est magnum hoc per se ipsum malum, quantum illud, quod permulti imitatores principum exsistunt. Nam licet videre, si velis replicare memoriam temporum, qualescumque summi civitatis viri fuerint, talem civitatem fuisse; quaecunque mutatis morum in principibus exstitert, eandem in populo secuturam. Idque haud paullo est verius quam quod Platoni nostro placet, qui musicorum cantibus ait mutatis mutari civitatum status. Ego autem nobilium vita victuque mutato mores mutari civitatum puto.

For it is not so great an evil that princes do wrong—though this evil is great in itself—as is this, that very many imitators of princes appear. For you can see, if you will unroll the page of the past, that as the chief men of a state have been, such has been the state; that whatever change of character has taken place in the rulers, the same change is sure to follow in the people. This is a good deal truer than the opinion of our favourite Plato, who holds that the condition of states changes as the songs of the musicians change. But I believe that as the life and fashions of their aristocracy change, the character of states changes with them.

B.

Illo non validus subiit juga tempore taurus;
non domito frenos ore momordit equus;
non domus ulla fores habuit; non fixus in agris,
qui regeret certis finibus arva, lapis.
Non acies, non ira fuit, non bella, nec ensem
immiti saevus duxerat arte faber.
Nunc Jove sub domino caedes et vulnera semper,
nunc mare, nunc leti mille repente viae.

At that time the strong ox bowed not his neck to the yoke; the horse did not champ the bit with enslaved jaws; no house had doors; no stone was fixed in the fields to mark out fields with sure boundaries. There was no armament, no strife, no wars, nor had the fierce smith fashioned the sword with pitiless art. Now, under Jove as our lord, are slaughter and wounds for ever; now is there sea, and a thousand ways that quickly lead to death.

C.

Di patrii, purgamus agros, purgamus agrestes,
vos mala de nostris pellite limitibus;
neu seges eludat messem fallacibus herbis,
neu timeat celeres tardior agna lupos.
Tunc nitidus plenis confisus rusticus agris,
ingeret ardenti grandia ligna foco.
Turbaque vernarum, saturi bona signa coloni,
ludet, et ex virgis extruet ante casas.

Our fathers' gods, we are cleansing our fields, we are cleansing our tillers; drive ye evils far from our borders. Let not the crop deceive our hopes of harvest with false weeds; nor let the slow lamb dread the wolves. Then the well-fed peasant trusting in his full fields shall pile the great logs on his blazing hearth; and the crowd of slavelings, clear token of a wealthy husbandman, shall sport and before his home shall build of twigs their huts.

The remainder of Answers will appear in our next issue.

Quarterly Arithmetical Tests.

Standard I.—First Quarter.

1. 418
   3
   90
   156
   7

2. 394
   261

3. 870
   50

4. 9 × 2;
   10 × 3;
   7 × 4.

Second Quarter.

1. 9
   43
   607
   80
   5

2. 427
   362

3. 950
   843

4. 8 × 3;
   9 × 4;
   12 × 6.

Third Quarter.

1. 46
   710
   8
   592
   63

2. 538
   239

3. 706
   48

4. 6 × 4;
   12 × 5;
   8 × 6.

Standard II.—First Quarter.

1. 47,098
   6,305
   814
   52
   80,670

2. From 36,090 take 7,804.

3. 69,803 × 59.

4. 12 × 8; 10 × 11; 11 × 12.

Second Quarter.

1. Take 307 from 10,001.
2. 90,476 × 730.
3. 43,825 ÷ 5.
4. 52d.; 77d.; 94d.

THIRD QUARTER.

1. From 56,013 take 46,928.

2. 78,394 × 618.

3. 63,612 ÷ 9.

4. 109d.; 127d.; 135d.

STANDARD III.—FIRST QUARTER.

1. Divide 43,341 by 17.

2. How often is eighty-three contained in three hundred and ninety thousand eight hundred and forty-seven?

3. Divide four million four hundred and thirteen thousand and thirty by five hundred and nine.

4. A book contains 97,088 words, with an average of 164 words on a page. How many *leaves* are there in the book?

SECOND QUARTER.

1. Add together three hundred and forty-eight pounds thirteen shillings and eightpence farthing, one hundred and nine pounds seven shillings and elevenpence, two thousand and ninety-four pounds eighteen shillings and fourpence halfpenny, nineteen pounds eleven shillings and a penny three farthings, and six thousand and one pounds fifteen shillings and tenpence farthing.

2. In a division sum the dividend is half-a-million, the quotient 698, and the remainder 232. Find the divisor.

3. From four hundred and sixty pounds thirteen shillings and sevenpence three farthings take seventy-two pounds eight shillings and tenpence halfpenny.

4. What is the amount of a guinea, a crown, half-a-crown, a florin, a sixpence, a penny, and a farthing?

THIRD QUARTER.

1. If 9,398 nuts were given to a number of children, and each boy received 18, whilst each girl received 19, how many children were there?

2. What must be taken from six thousand seven hundred and four pounds twelve shillings and twopence farthing to leave five thousand eight hundred and ninety pounds thirteen shillings and elevenpence halfpenny?

3. £928 17s. 10½d. + 16s. 8¼d. + £5 13s. 7¾d. + 5¼d. + £20 18s. 11¾d. + £3,007 19s. 6d.

4. How many oranges at seventeen for a shilling can you get for three guineas?

STANDARD IV.—FIRST QUARTER.

1. £60 15s. 8¼d. × 75.

2. What is the cost of four hundred and ninety houses at seven hundred and thirty-six pounds nineteen shillings and eleven pence each?

3. Divide ten thousand and fifteen pounds eleven shillings and nine pence halfpenny by eight.

4. If 736 horses cost £35,305, what is the cost of each horse?

SECOND QUARTER.

1. Reduce 15 miles 6 fur. 30 po. 4 yds. to inches.

2. How many half-pence are equal to £607 15s. 10d?

3. Reduce one million three thousand and four grains to pounds (Troy).

4. Find the sum of nineteen sovereigns, nineteen half-sovereigns, nineteen shillings, nineteen sixpences, nineteen pence, and nineteen farthings.

THIRD QUARTER.

1. How many half-pounds of sugar are there in a cask containing 11 cwt. 2 qrs. 26 lbs.

2. Take 5s. 2¼d. from a sovereign and multiply the remainder by 706.

3. Reduce 7 qrs. 6 bus. 2 pks. 1 gal. to pints.

4. From 15 square yards of glass how many panes can be cut out measuring 9 inches by 6?

STANDARD V.—FIRST QUARTER.

1. What is the value of 9,407⅜ tons at 19s. 7¾d. per ton?

2. Find the cost of 47 yds. 2 ft. 7 in. at 18s. 9d. per yard.

3. What would 18,653 cows cost at £17 14s. 3d. each?

4. Find the value of 29 ac. 3 ro. 38 po. at £120 16s. 8d. per acre.

SECOND QUARTER.

1. Make out a bill for:—
   5¼ lbs. tea at 3s. 6d. per lb.
   42 lbs. sugar at 2s. 9d. per doz. lbs.
   17 lbs. cheese at £5 2s. 8d. per cwt.
   26 lbs. bacon at 8½d. per lb.
   9½ lbs. coffee at 1s. 8d. per lb.

2. If I have sufficient provisions to last 72 horses for 25 days, how long will the provisions last 40 horses?

3. What is the value of 7 tons 18 cwt. 69 lbs. at £8 3s. 4d. per cwt.?

4. If 28 men can do a piece of work in 15 weeks, how many more men must be employed to complete it in 12 weeks?

THIRD QUARTER.

1. Take $\frac{1}{7}$ from $\frac{1}{6} + \frac{1}{8}$.

2. From 49 sheep 17 cwt. 3 qrs. 21 lbs. of wool is obtained; what number of sheep will give 3 tons 1½ cwt.?

3. From $\frac{2}{3}$ of a yard take $\frac{1}{4}$ of a yard. How many inches remain?

4. A bankrupt owes £760 10s., but can only pay 7s. 6d. in the £. What do his creditors lose?

STANDARD VI.—FIRST QUARTER.

1. How many times can $5\frac{7}{9}$ be subtracted from $225\frac{1}{3}$?

2. Reduce $\frac{5}{512}$ and $\frac{9}{80}$ to decimals, and find the difference between them.

3. A boy was asked to divide $\frac{1}{4}$ by $\frac{1}{8}$, but, instead, he divided $\frac{1}{8}$ by $\frac{1}{4}$. How much too small was his answer?

4. Simplify—

$$\frac{\cdot 739 - \cdot 45}{\cdot 0017} \times \frac{\cdot 85}{36\cdot 7 + 5\cdot 8}$$

SECOND QUARTER.

1. What will the tax on £395 12s. amount to at 1s. 0½d. in the £?

2. Find the value of ·285714 of 5 cwt. + ·0625 of 3 qrs. + ·09375 of 18 lbs.

3. If $\frac{2}{3}$ of a ship is worth £11,720, what is the value of $\frac{7}{8}$ of $\frac{9}{5}$ of ½ of the ship?

4. What decimal of £2 0s. 6½d. is $\frac{9}{11}$ of £3 3s. 8½d.?

THIRD QUARTER.

1. Find the amount of £710 6s. 3d. for 3 years at 4½ per cent.

2. I spent $\frac{3}{5}$ of my money, gave away ⅓ of the remainder, and then had £27 15s. 9d. left. How much had I at first?

3. What sum will amount to £696 18s. in 4 years at 5 per cent.?

4. In what time will £635 amount to £685 16s. at 4 per cent.?

STANDARD VII.—FIRST QUARTER.

1. If 7 persons earn £14 19s. 3d. in 9 days, what will 11 persons earn in 5 days?

2. What is the simple interest on £1,977 14s. 2d. for 250 days at 4½ per cent.?

3. The gas consumed by 57 burners in 42 hours cost 19s. What would be the expense of allowing 7 of them to burn 2 hours 15 minutes?

4. If £702 gain £109 13s. 9d. in 2½ years, what is the rate per cent. per annum?

SECOND QUARTER.

1. Find the present value of £796 19s. 7½d. due in 3 years at 3½ per cent.

2. A man earned £216 5s. in the 1st year, £179 13s. in the 2nd, and £302 10s. in the 3rd. How much should he earn in the 4th year, so as to earn on the average £250 a year for the 4 years?

3. Find the amount of £750 for 2 years at 4 per cent. compound interest.

4. Find the average of 6·05, ·732, 49·6001, ·8, 1, and 503·479.

THIRD QUARTER.

1. The rent of a house was lowered from £67 10s. to £64 16s. How much per cent. was it lowered?

2. If by selling 34 yds. of cloth at 3s. 9½d. per yard a tailor gains 9s. 11d., what was the prime cost per yard and the gain per cent.?

3. Find the income from investing £4,551 15s. in the 4½ per cents. at 89½, brokerage ⅛ per cent.

4. A collector's commission amounts to £52 3s. 9½d. If he is paid at the rate of 3¼ per cent., what amount has he collected?

ANSWERS.

STANDARD I.

	FIRST.	SECOND.	THIRD.
1.	674	744	1,419
2.	133	65	99
3.	820	107	658
4.	18; 30; 28	24; 36; 72	24; 60; 48

STANDARD II.

	FIRST.	SECOND.
1.	134,939	9,694
2.	28,286	66,047,480
3.	4,118,377	8,765
4.	96; 110; 132	4s. 4d.; 6s. 5d.; 7s. 10d.

THIRD.

1. 9,085
2. 48,447,492
3. 7,068
4. 9s. 1d.; 10s. 7d.; 11s. 3d.

STANDARD III.

	FIRST.	SECOND.	THIRD.
1.	2,549 + 8	£8,574 6s. 11¾d.	508 children
2.	4,709 times	716	£813 18s. 2¾d.
3.	8,670	£388 4s. 9½d.	£3,964 7s. 1½d.
4.	296 leaves	£1 11s. 1¼d.	1,071 oranges

STANDARD IV.—FIRST.

1. £4,558 16s. 6¾d.
2. £361,127 19s. 2d.
3. £1,251 18s. 11½d. + 6
4. £47 19s. 4½d.

SECOND.

1. 1,004,004 inches.
2. 291,740 half-pence.
3. 174 lbs. 1 oz. 11 dwts. 20 grs.
4. £30 0s. 5¾d.

THIRD.

1. 2,628 half-pounds.
2. £522 17s. 7½d.
3. 4,008 pints.
4. 360 panes.

STANDARD V.—FIRST.

1. £9,240 16s. 2½d.
2. £44 17s. 4¾d.
3. £330,391 5s. 3d.
4. £3,623 9s. 9½d.

SECOND.

1. 18s. 4½d. + 9s. 7½d. + 15s. 7d. + 18s. 5d. + 15s. 10d. = £3 17s. 10d.
2. 45 days.
3. £1,295 7s. 3½d.
4. 7 men.

THIRD.

1. $1\frac{3}{16}$.
2. 168 sheep.
3. 15 inches.
4. £475 6s. 3d.

STANDARD VI.—FIRST.

1. 39 times.
2. ·04375.
3. $\frac{9}{10}$.
4. 3·4.

SECOND.

1. £20 12s. 1d.
2. 5 qrs. 26 lbs. 15 oz.
3. £4,614 15s.
4. ·428571.

THIRD.

1. £806 4s. 1½d.
2. £55 11s. 6d.
3. £580 15s.
4. 2 years.

STANDARD VII.—FIRST.

1. £13 1s. 3d.
2. £60 19s. $1\frac{91}{176}$d.
3. 1½d.
4. 6¼ per cent.

SECOND.

1. £721 5s.
2. £301 12s.
3. £811 4s.
4. 93·610183.

THIRD.

1. 4 per cent.
2. 3s. 6d.; 8⅓ per cent.
3. £229 10s.
4. £1,605 16s. 8d.

—o—

Helps to the Study of Shakespeare's 'Hamlet.'

ACT II. Scene 2.

Line 2. *Moreover that,*— besides that.

Line 5. *transformation; so call it.*—Note that either 'transformation' must be pronounced as five syllables, or another reading may be adopted, 'so I call it.'

Line 6. *sith nor*,—since neither. Mr. Marsh in his '*Lectures on the English Language*' says 'sith' was used by good authors only in the logical sense as an illative word, while *sithence* and *since* were used only as narrative words denoting time after. 'Since' is a contraction of *sithennes* or *sithence*, the genitive of *sithen* or *sith*.

Lines 7—10. Note in these lines use of *that* for what, *should* for may, *put* followed by *from, of* after *dream* redundant.

Line 11. *of so young days*,—from such early days.

Line 12. *so neighbour'd to his youth and haviour*,—so intimately associated with his youth and humour, so well acquainted with his character and habits.

13. *that you vouchsafe your rest*,—grant us the favour of remaining: 'that' is redundant, being a repetition of 'that' two lines above.

Lines 14—18. Note use of plural abstract noun *companies, occasion* for 'opportunity,' *whether* as monosyllable *whe'r*.

within our remedy,—within our power to remedy.

Line 22. *gentry*,—abstract noun for courtesy. See the phrase 'calendar of gentry' in Act V., Sc. 1. This word is now used as a collective noun.

Lines 23—26. *expend*,—more exact form of *spend*, as *example* is of *sample*.

supply and profit,—help and furtherance. *visitation*, for visit. Shakespeare only uses the latter form as a verb. *As fits*,—as befit. Note the plural form 'thanks' is often used with singular verb, like its equivalent 'gratitude.'

Line 27. *of us*,—over us.

Line 30. *full bent*,—intention, inclination.

Line 42. *still*,—always, constantly.

Line 47. *hunts not the trail of policy so sure*,—follows not the indications of good judgment so surely.

Line 49. *lunacy*,—madness, from Lat. *Luna*, the moon, from the old supposition that madness was caused by the influence of the moon; hence the word *moonstruck*.

Line 52. *fruit*,—dessert. The message of the ambassadors being compared to a banquet, the discovery of Polonius may be compared to the dessert after it.

Line 56. *I doubt it is no other but the main*,—I suspect it is no other than the main cause.

Line 61. *Upon our first*,—As soon as we made our first request.

Line 63. *the Polack*,—the Pole. Poland.

Line 64. *better look'd into*,—forming with 'which' an absolute phrase; *truly* modifies 'was' not 'found.'

Line 67. *borne in hand*,—deluded. *sends* for 'he sends.'

Line 71. *to give the assay of arms*,—to carry a quarrel to the extremity of war. 'assay' means trial or test.

Line 77. *quiet pass*,—free passage.

Line 79. *such regards of safety*,—such conditions and regulations as may secure the safety of the country passed through.

Line 80. *It likes us well*,—It is well pleasing to me: 'us' is the dative governed by 'likes.'

Line 81. *more consider'd time*,—time more fitting for consideration of the subject.

Line 83. *well-took labour*,—well-taken mission. The form now used for the past tense is often used by Shakespeare for the participle—*spoke* for spoken, *forgot* for forgotten, *drove* for driven.

Line 85. *expostulate*,—discuss fully. The modern meaning is rather to remonstrate, the derivation Lat. *ex*, out, *postulo*, I demand.

Line 95. *More matter, with less art*,—Say more, with fewer words, like the expression 'come to the point.' Notice in these speeches of Polonius the intensely artificial style of the sentences, intended probably not only to indicate his conceit and self-importance, but also to illustrate and satirise the affected style which prevailed in the time of Shakespeare.

Line 98. *a foolish figure*,—empty figure of speech, in allusion to the word conceit—''tis true 'tis pity, and pity 'tis 'tis true,' which, taking the first two words together and the last two, reads the same backwards as forwards.

Lines 100—101. *effect, defect*,—both these words refer to madness.

Line 104. *the remainder thus*,—the remainder is thus.

Line 105. *Perpend*,—consider carefully, weigh and consider, from Lat. *perpendere*, to weigh accurately.

Line 109. *beautified*,—endowed with beauty. Though this word seems to grate upon the ears of Polonius, it is of the class he uses so excessively.

Line 113. *white bosom*,—'The ladies of Elizabeth's reign wore a pocket in the front of their stays, in which they carried their love-letters and love-tokens.'

Lines 116—119. The meaning of 'doubt' varies in this quatrain. In the first and second lines it means feel uncertain, in the third suspect, and in the last have misgiving.

Line 120. *ill at these numbers*,—unskilful in making verses.

Line 121. *art to reckon*,—skill to tell in measured lines.

Line 124. *this machine is to him*,—this body belongs to him.

Line 132. *I would fain*,—I would gladly. 'Fain' used adverbially is originally the past participle of an Anglo-Saxon verb, to rejoice. In the Midland counties the word is still colloquially used as an adjective, very often for desirous, or inclined.

Line 137. *played the desk or table-book*,—assisted in their correspondence, as by recording it only in the memory.

Line 138. *given my heart a winking*—allowed myself to connive at the matter.

Line 140. *I went round to work*,—I took a plain straightforward course. In Act III., Scene 4, Polonius counsels the Queen 'to be round' with Hamlet, that is to speak plainly to him.

Line 141, *bespeak*,—address.

Line 142. *out of thy star*,—out of thy sphere. Another instance of the influence of belief in astrology on the English language.

Line 143. *prescripts*,—directions, precepts.

Line 146. *the fruits of my advice*,—my counsel and its consequences.

Lines 149—152. *watch*,—wakefulness, inability to sleep; *lightness*,—light-headedness. 'which' is understood before 'all.' *all we* is for 'we all.'

Line 160. *the centre*,—the centre of the earth.

Line 163. *I'll loose my daughter,*—I will remove the restraint on my daughter. The Clarendon editors remark that 'the word "loose" is more frequently used of dogs than men;' but in the North of England it is common to speak of 'loosing' men from work and children from school.

Line 164. *Arras,*—tapestry forming curtains or hangings for a room. This word is an instance of the name of an article being derived from the name of the place where it was made: Arras is a town in the north of France, formerly famous for tapestry. Compare *calico* from Calicut; *bayonet* from Bayonne; *diaper* from d'Ypres.

Line 166. *thereon,*—on that account.

Line 171. *board,*—accost, from French *aborder*, to address.

Line 176. *excellent,*—for excellently.

Lines 182, 183. *For if the sun . . . a god kissing carrion.*—It has been suggested that this is a quotation from the book Hamlet is reading, and it is so printed in Staunton's edition. Light is thrown on its meaning by an extract from the play of Edward III., printed as possibly Shakepeare's.

> 'The freshest summer's day doth soonest taint
> The loathed carrion that it seems to kiss.'—Act II. Sc. 1.

No good influence can bring anything but evil out of what is corrupt.

Line 188. *How say you by that?*—What do you say with reference to that? *By* is used in the same sense in 1 Corinthians iv. 4.

Line 194. *matter,*—subject of the book. Hamlet pretends to understand 'matter' as cause of dispute.

Line 195. *who* for whom.

Line 197. *the satirical rogue.* Warburton suggests that Hamlet is supposed to be reading Juvenal's Tenth Satire. 'Satirical' is from *satire*, a form of poetry in which folly and vice are held up to ridicule.

Line 199. *purging,*—discharging.

Lines 208—210. *How pregnant sometimes his replies are! . . . delivered of.*—How full of meaning are some of his answers! Such fitness of expression sometimes occurs to one who is mad, as a sane and rational person would strive in vain to find.

Line 219. *tedious,*—wearisome through garrulous conversation: from Latin *tædium*, weariness.

Line 227. *indifferent children of the earth,*—ordinary people.

Line 228. *Happy, in that . . . . the very button,*—We are fortunate in not being too fortunate: we do not occupy the most exalted position.

Line 235. *doomsday,*—the day of judgment, from *doom*, judgment, from Anglo Saxon, *deman* to judge, cognate with deem, dempster.

Line 242. *confines,*—places of confinement: more frequently used in the sense of boundaries.

Line 261. *by my fay,*—by my faith: 'fay' may be a contraction of faith, or a corruption of the old French *fei*, faith, in modern French *foi*.

Line 263. *I will not sort you,*—put you in the same set or company. Sometimes 'sort' is used in the sense to choose, sometimes to suit or fit.

Lines 265, 266. *In the beaten way of friendship, what make you at Elsinore?*—Speaking as old friends, what brings you to Elsinore? 'Make' is similarly used in Act I. Sc. 2.

Line 270. *too dear a halfpenny,*—too dear at a halfpenny, not worth a halfpenny.

Line 271. *your own inclining,*—your own inclination, of your own free will.

Line 276. *your modesties.*—Another instance of abstract noun in plural number. *craft enough to colour,*—artfulness enough to conceal.

Line 279. *conjure you,*—earnestly implore you.

Line 280. *consonancy of our youth,*—our agreement in early days.

Line 282. *a better proposer,*—one who could more skilfully appeal to you, put the matter before you.

Line 283. *even,*—straightforward.

Line 286. *of you,*—upon you.

Line 290. *prevent your discovery,*—anticipate and so stop your disclosure.

Line 291. *moult no feather,*—lose no feather. 'Moult' is from old English *mouten*, Latin *mutare*, to change, and applies to the periodical change of feathers by birds.

Line 292. *forgone,*—abandoned; *for* is the negative prefix already noted.

Lines 294, 295. *sterile promontory,*—barren rock. *brave,*—splendid: compare Scotch use of *braw*.

Line 296. *fretted,*—adorned, from Anglo Saxon *fraetwian*, to adorn: compare *fretwork*, a form of ornamentation in wood or stone.

Line 298. *pestilent congregation of vapours,*—collection of vapours producing plague.

Line 300. *express,*—exactly fitted to its purpose.

Line 302. *paragon,*—perfect model, matchless pattern; from Spanish *para, con.*, a compound preposition signifying in comparison with.

Line 303. *quintessence,*—a term used by the alchemists to denote the fifth or final essence remaining after the extraction of the four elements from any substance.

Line 310. *lenten,*—meagre, suitable to the season of Lent.

Line 311. *coted,*—overtook, came up by the side of, passed: 'cote' is a term used in coursing, not used elsewhere by Shakespeare. Fr. *coté*, side.

Line 316. *the humorous man,*—the man full of humours or caprices.

Line 317. *tickle o' the sere,*—easily moved to laughter, like a gun which goes off with the least touch of the trigger. This is the explanation of the Clarendon edition. 'tickle' means ticklish. The word is used as an adjective in the north of England to denote hazardous, or easily going wrong. 'sere,' now spelt *sear*, formerly *serre*, means a catch in a gunlock by which the trigger is moved. The sentence implies a poor opinion of the clown's wit.

Line 318. *the lady—halt for't*—The lady may speak as she pleases, even if she spoils the blank verse.

Line 321. *the city,*—Copenhagen, from which they have travelled to Elsinore.

Lines 322, 323. *their residence . . . . both ways,*—remaining in the city would be more to their advantage, both as regards their repute and their gain.

Lines 324, 325. *inhibition . . . . innovation,*—Johnson suggests that these words should change places, and the suggestion seems very reasonable. The sentence then means that the novelty of the city players travelling is the result of restrictions placed upon them. In 1600–1 the licence for stage plays in London was limited to the Globe theatre, Bankside,

and the Fortune theatre in Golden Lane. Players, being prohibited from acting in or near the city, became travelling or strolling players, acting in the country.

Line 326. *estimation*,—value.

Lines 331—333. *An aery of children, little eyases, that cry out on the top of question, and are most tyranically clapped for't*,—A nestful of children, little fledglings, who sing out in a shrill voice, and are applauded in a bigoted or one-sided fashion. 'Aery' means a brood of eagles or hawks, from Low Latin *area*, a nest of a bird of prey: it is often spelt *eyry*, and wrongly supposed to be derived from *egg*, *eggery*; 'eyas' is derived from French *niais*, a nestling, by dropping of the *n*: compare *adder*, from *nedder*; *apron*, from *naperon*; *orange*, from *naranja*; 'top of question' means in a high key. It has been suggested that 'question' refers to the torture of the rack; also that the dramatist is thinking of the overstrained modulation of children's voices in interrogation. In Shakespeare's time much encouragement was given to dramatic performances by the children of St. Paul's, and the Chapel Royal, and some others. The patronage of these caused some neglect of adult players, and jealousy on the part of the latter and their friends.

Line 338. *escoted*,—paid for. Fr. *escotter*, to pay the scot, that is an individual's share in a common charge. Compare 'scot and lot,' modern 'shot.' *quality*,—profession of players, a technical term of the time.

Line 344. *tarre*,—exasperate, provoke, from Anglo-Saxon *tirian*: more often applied to urging dogs to fight. Compare King John, Act IV., Scene 1.

Line 345. *argument*,—plot of a play.

Line 349. *carry it away*,—gain the victory, bear the palm. 'It' is here used impersonally.

Line 350. *Hercules and his load too*:—Stevens suggests that Rosencrantz, taking the word 'carry' in another sense, here alludes to the sign of the Globe theatre, Hercules carrying the earth.

Lines 352—355. *It is not very strange . . . picture in little*.—After all this change need not be wondered at, for now my uncle is king, and those who only mocked at him while my father lived, now give large sums for his miniature; 'make mows' means make grimaces: 'mows' is not a corruption of mouths, but mouths has erroneously been substituted for the original word in Psalm xxxv. v. 15. 'ducat,' a foreign coin, first struck by a duke, value 4s. 6d. in silver, 9s. in gold.

Query Column.

RULES.

1. Each correspondent is restricted to *one question*. We should be much obliged if correspondents, who send questions for solution, would give (if possible) the required answer, and the source from which the question is obtained.

2. No query can be answered unless accompanied by the real name and address of the sender, not necessarily for publication, but as a guarantee of good faith and for facility of reference.

3. ☞ **When a pseudonym is adopted it should be written at the end of the query, and the real name and address on a separate piece of paper.**

4. Correspondents are requested to write their queries *legibly*, and on one side of the paper only.

5. Replies will not be sent through the post.

6. Queries must reach the office *not later than the 12th of the month*, or they cannot be attended to in the following issue.

*** All communications for this column should be addressed—'*The Query Editor*,' *The Practical Teacher*, *Pilgrim Street, Ludgate Hill, London, E.C.*

General.

1. ASTYANAX.—(*a*) The *reciprocal* of a number is generally defined as the quotient after dividing 1 by the number; *e.g.*, $\frac{1}{6}$ is the reciprocal of 6, $\frac{3}{5}$ is the reciprocal of $\frac{5}{3}$. See *Capel's* 'Catch Questions in Arithmetic and Mensuration' (J. Hughes).

(*b*) Thanks. Errors were discovered.

2. DOUBTFUL.—The solution you send of II. 4 would *not* be taken at a Government Examination of Pupil Teachers, but it might be given *in addition* to the ordinary solution.

Remember that only generally understood abbreviations for *words* may be used, but no symbols of *operations* (such as −, ÷, ×) are admissible.

3. ROSE.—There is no need to use Algebra in the Arithmetic paper. It may not be prohibited but you must remember that your methods should be such as you would expect to be used in a school. Writing, large hand, 65 and 70. Both specimens are imperfect. The forms, especially the curves, are incorrect. The small hand is not worse. Pay attention to slope and curves and joinings. 70.

4. H. M.—Read the Lessons on the subject that have passed through this Magazine. *Huxley's* 'Physiography' would be very useful to you.

5. PARCHMENT.—We know of no change. Should we hear of one we will insert it next month.

6. IXION.—The syllabus of the Science and Art Department can be had through any bookseller. It is published by the Department and sold for 6d. Order the last edition. For Algebra there are many excellent books, *Todhunter's*, *Smith's*, or the newest, and for your purpose perhaps the best, *Hall* and *Knight's* 'Algebra.' Parts I. and II. For Geometry any of the usual text books by *Potts*, *Todhunter*, *Casey*, *Mackay*, or *Nixon* will do. For Trigonometry *Lock's* 'Trigonometry' (Elementary). The use of Theodolite, &c., can be studied in a small volume by *Weale* on Surveying. For the requirements for the Arts degree write for a copy of the syllabus which will be sent to you post free on application to the Registrar of the London University, Burlington Gardens, Piccadilly, W.C.

7. RIVINGTON PIKE.—You should read the syllabus very carefully or you may waste a good deal of time. Bacon's essays are set for the 2nd year.

8. ARAMIS.—(1) The pen is obviously wrongly held, this accounts for the very jagged edges of the curves. The capital E and the small f are of the wrong pattern. There is not much variety in the letters chosen, but you have a good idea of form and symmetry, 75. (2) The same remarks largely apply. The pen and the ink too, may have been bad; anyhow the slopes and joinings lack neatness and finish, 70. (3) There is a decided falling off in the sense of form shown in No. 1, the letters r, c, n, s, are badly made though not uniformly so. You would soon write a really good hand if you would take the advice we are constantly giving—get some recognised models and practice for a short time daily.

9. ET TU BRUTE.—Your list is satisfactory. Read some portions of Pt. II. of the 'Principia.' You could use *Abbott's* 'Via Latina,' a very good book. For Physical Geography, use *Huxley's* 'Physiography.' Use *Cowham's* Copybooks, published by J. Hughes.

10. PRACTICAL.—We will inform you of the objects given as you wish. Meantime for almost all specimens you require you could write to Bolton, Birmingham. For large objects, frogs, crayfish, snails, &c., you might write to Leach, Naturalist, St. Martin's Lane.

11. JOAN AB DEUR.—The answer to your query is *No.* Read the instructions carefully and you will come to the same conclusion yourself. Pay attention to English. You do not seem to understand the usage of 'shall' and 'will.'

12. BRADFORD.—Large hand writing too upright. The capital is not right as to shape. The down strokes are all jagged owing to your holding your pen improperly. The joinings are clumsy, 65. The capitals in the small hand are bad, both inelegant and incorrect. It is much too upright, the letters p, l, d, y, are entirely wrong as to shape. Both the large and small hand are legible and show promise. A few lessons from a competent teacher or a really serious attempt on your part to imitate good models would produce a great change in a short time, 65.

13. VADE MECUM.—In *Webster's* 'Improved Dictionary' (Mackenzie), you will find an Essay on the history of the art of writing. Chapter fourteen of it is upon the origin and progress of the present and cursive hand and the use of capitals.

2. You should look and see for yourself. Of course it will not. The reason for giving up Greek is to allow Students of Law, Medicine, and Science to make other use of their time, not to excuse the Student who intends taking a degree in arts.

3. We have referred your enquiry to the Editor.

14. MECHANIC.—A force pump is used to raise water from a well to a tank. If the pump be 18 feet above the well, and 54 feet below the tank, and if the area of a section of the plunger be six square inches find :—

(1) The force required to work the pump when sucking.
(2) The force required to work the pump when lifting.
(3) The work done during a double stroke of 4 inches each way. (*Blackie's Mechanics.*)

Ans. (1) $46\frac{2}{3}$ lbs.
,, (2) $140\frac{2}{3}$ lbs.
,, (3) $62\frac{1}{2}$ foot pounds.

You want the vertical distance of the plunger and the cistern respectively above the level of the water in the well; in this case 18 and 54 feet. The cross section of the plunger is 6 inches. Then (1) to force down the plunger will require a force equal to that exerted by $6 \times 18 \times 12$ cubic inches of water $= \frac{6 \times 18 \times 12 \times 1000}{1728 \times 16} = 46\frac{2}{3}$ lbs. (2) To lift the water requires a force of $\frac{6 \times 54 \times 12 \times 1000}{1728 \times 16} = 140\frac{2}{3}$ lbs. (3) A double stroke consists of a force of—

$46\frac{2}{3}$ lbs. working through 4 inches, and a force of
$140\frac{2}{3}$ lbs. ,, ,, 4 ,,
$= 187\frac{1}{2}$ lbs. ,, ,, 4 ,,
$= \frac{187\frac{1}{2}}{3}$ lbs. ,, ,, one foot
$= 62\frac{1}{2}$ foot pounds.

15. R. SIMPSON—A book 5·5 in. from the centre of light is held parallel to a wall, the shadow of which is found to be 400 sq. inches. How much would this shadow be diminished if the book were brought $2\frac{1}{2}$ in. nearer.

210·9375 sq. in. Ans.

Hold a card as stated in the question. You will see that if the card is brought nearer the centre of light the shadow is enlarged, the card must therefore be brought $2\frac{1}{2}$ ins. nearer the wall. We shall then obtain the size of the reduced shadow, thus :—

$$8^2 : (5\tfrac{1}{2})^2 :: 400 :: x$$

$$x = \frac{\overset{25}{\cancel{100}}}{\underset{1}{\cancel{400}}} \times \frac{121}{\underset{4}{\cancel{16}}} \times \frac{1}{\underset{16}{\cancel{64}}} = 189{\cdot}0625$$

and $400 - 189{\cdot}0625 = 210{\cdot}9375$ sq. in.

16. R. FISH.—If $x = r \sin\theta \cos\phi$, $y = r \sin\theta \sin\phi$, $z = r \cos\theta$, show that $x^2 + y^2 + z^2 = r^2$. (*Atkins.*)

$$\begin{aligned} x^2 + y^2 + z^2 &= r^2 \sin^2\theta \cos^2\phi + r^2 \sin^2\theta \sin^2\phi + r^2 \cos^2\theta \\ &= r^2 \sin^2\theta (\sin^2\phi + \cos^2\phi) + r^2 \cos^2\theta \\ &= r^2 \sin^2\theta + r^2 \cos^2\theta \\ &= r^2 (\sin^2\theta + \cos^2\theta) \\ &= r^2. \end{aligned}$$

17. ALBION.—You will find *Richardson's* 'Geometrical Conics' published by Rivington and Co., 4/6, an excellent book. The proofs are very clearly given. Try it if you have not got it already.

18. R.E.—We will enquire for you.

Algebra.

1. TAU.—(*a*) Find the sum of all the even numbers which are between 101 and 999.

(*b*) Find the sum of all the numbers between 100 and 500 which are divisible by 3.

These are questions in Arithmetical Progression.

(*a*) First term = 102, last term = 998, difference = 2;

$$\begin{aligned} l &= a + (n-1)d, \\ 998 &= 102 + 2(n-1) \\ 2(n-1) &= 998 - 102 \\ &= 896 \\ n - 1 &= 448 \\ \therefore n &= 449. \end{aligned}$$

$$\begin{aligned} S &= (a + l) \times \frac{n}{2} \\ &= (102 + 998) \times \tfrac{449}{2} \\ &= 1100 \times \tfrac{449}{2} \\ &= \frac{493900}{2} \\ &= \underline{246{,}950}. \quad \text{Ans.} \end{aligned}$$

(*b*) First term = 102, last term = 498, difference = 3;

$$\begin{aligned} l &= a + (n-1)d; \\ 498 &= 102 + 3(n-1) \\ 3(n-1) &= 498 - 102 \\ &= 396 \\ n - 1 &= 132 \\ \therefore n &= 133. \end{aligned}$$

$$\begin{aligned} S &= (a + l) \times \frac{n}{2} \\ &= (102 + 498) \times \tfrac{133}{2} \\ &= 600 \times \tfrac{133}{2} \\ &= 133 \times 300 \\ &= \underline{39{,}900}. \quad \text{Ans.} \end{aligned}$$

2. BLOBS.—Out of 17 consonants and 5 vowels, how many words can be formed, each containing 2 consonants and 1 vowel? (*Todhunter.*)

Out of the 17 consonants we get $\frac{17 \times 16}{1 \cdot 2}$ combinations of two;

$\therefore \frac{17 \times 16}{1 \cdot 2} \times 5$ expresses the number of ways in which we can get two consonants and one vowel;

And each combination of three letters gives rise to $\lfloor 3$ permutations;

$$\begin{aligned} \therefore \text{number of words} &= \frac{17 \times 16}{1 \cdot 2} \times 5 \times \lfloor 3 \\ &= 17 \times 16 \times 5 \times 3 \\ &= 51 \times 80 \\ &= \underline{4{,}080}. \quad \text{Ans.} \end{aligned}$$

Note.—$n(n-1)(n-2)\ldots(n-r+1) \times \lfloor n-r$
$= 1 \cdot 2 \cdot 3 \ldots (n-r) \times (n-r+1)\ldots(n-2)(n-1)n$
$= \underline{\lfloor n}.$

3. DUFFER. — (1) On the ground are n stones; the distance between the first and second is one yard, between the second and third three yards, between the third and fourth five yards, and so on. How far will a person have to travel who shall bring them, one by one, to a basket placed at the first stone?

(2) Find a series of arithmetical means between 1 and 21, such that their sum has to the sum of the two greatest of them the ratio of 11 to 4. (*Todhunter.*)

(*a*) There are $n - 1$ journeys. The first journey is 2 yards, the second $2(1 + 3)$ yards, the third $2(1 + 3 + 5)$ yards, and so on.

Thus, the first journey is (2×1) yards, the second (2×4) yards, the third (2×9) yards, and so on.

$$\therefore \text{Distance} = 2(1 + 4 + 9 + \ldots) \text{ yards to } (n - 1) \text{ terms}$$
$$= 2(1^2 + 2^2 + 3^2 + \ldots) \text{ yards to } (n - 1) \text{ terms}$$
$$= \frac{2(n-1)n(2n-1)}{6} \text{ yards.} \quad \text{(See Art. 460)}$$
$$= \tfrac{1}{3}(n-1)n(2n-1) \text{ yards.} \quad \text{Ans.}$$

(*b*) Let n denote the number of means,

Then $21 = 1 + (n + 1)d$,

$$\therefore d = \frac{20}{n+1}.$$

First mean $= 1 + d$,

Last mean $= 21 - d$;

$$\therefore \text{Sum of means} = \frac{n}{2}(1 + d + 21 - d)$$
$$= 11n;$$

The two greatest means are the two last, viz., $21 - d$ and $21 - 2d$,

$$\text{Sum of these means} = 42 - 3d;$$
$$\therefore 11n : 42 - 3d :: 11 : 4,$$
$$4 \times 11n = 11(42 - 3d)$$
$$4n = 42 - 3d$$
$$= 42 - \frac{60}{n+1}$$
$$4n^2 + 4n = 42n + 42 - 60$$
$$4n^2 - 38n = -18$$
$$n^2 - \frac{19n}{2} = -\frac{9}{2}$$
$$n^2 - \frac{19n}{2} + (\tfrac{19}{4})^2 = \tfrac{361}{16} - \tfrac{9}{2}$$
$$= \frac{361 - 72}{16}$$
$$= \tfrac{289}{16}$$
$$n - \tfrac{19}{4} = \pm \tfrac{17}{4}$$
$$\therefore n = \pm \tfrac{17}{4} + \tfrac{19}{4}$$
$$= 9, \text{ or } \tfrac{1}{2}.$$

The only admissible value is 9;

$$d = \frac{20}{n+1}$$
$$= 2.$$

$\therefore$ There are 9 means, 3, 5, 7.....19.

4. C. W. GALE.—If $a : b :: c : d :: e : f$, show that—

$$\frac{a}{b} = \frac{\sqrt[n]{pa^n + qc^n + re^n}}{\sqrt[n]{pb^n + qd^n + rf^n}}$$

(*Matriculation*, January, 1880.)

Let $k = \frac{a}{b} = \frac{c}{d} = \frac{e}{f}$,

Then $kb = a$, $kd = c$, $kf = e$;

$$\therefore p(kb)^n + q(kd)^n + r(kf)^n$$
$$= pa^n + qc^n + re^n,$$
$$k^n(pb^n + qd^n + rf^n) = pa^n + qc^n + re^n,$$
$$k^n = \frac{pa^n + qc^n + re^n}{pb^n + qd^n + rf^n},$$
$$k = \left(\frac{pa^n + qc^n + re^n}{pb^n + qd^n + rf^n}\right)^{\frac{1}{n}};$$
$$\therefore \frac{a}{b} = \frac{\sqrt[n]{pa^n + qc^n + re^n}}{\sqrt[n]{pb^n + qd^n + rf^n}}.$$

5. DESIROUS. — If a person lend £7,000 at 6 per cent. compound interest, and allow the interest to accumulate in the hands of the creditor, except £240 which he draws for expenses, how much did the creditor owe him at the end of 16 years?

If R denote the amount of one pound in one year, P the principal in pounds, M the amount, and n the number of years,

Then at compound interest
$$M = PR^n;$$
If A denote an annuity in pounds,

Then at compound interest
$$M = \frac{R^n - 1}{R - 1} A.$$

$$\therefore \text{Amount in pounds} = 7000(1{\cdot}06)^{16} - \left(\frac{1{\cdot}06^{16} - 1}{1{\cdot}06 - 1} \times 240\right);$$

$$\begin{cases} \text{Log } 1{\cdot}06^{16} = {\cdot}0253058653 \times 16 \\ \qquad\qquad = {\cdot}4048938448 \\ \qquad\qquad = \log 2{\cdot}54035144 \end{cases}$$

$$\therefore \text{Amount} = £[2{\cdot}54035144 \times 7000 - \left(1{\cdot}54035144 \times \frac{40}{240} \times \frac{100}{6}\right)]$$

£
17782·46008
6161·40576
11621·05432
20
s. 1·08649
12
d. 1·0368

$$= £11{,}621 \text{ 1s. 1d.} \quad \text{Ans.}$$

6. PENBWL. — Show, without extracting roots, that $\sqrt{17} + \sqrt{19}$ is less than $6\sqrt{2}$. (*Second Stage, Mathematics*, 1887.

$$(\sqrt{17} + \sqrt{19})^2 = 17 + 2\sqrt{17 \times 19} + 19$$
$$= 36 + 2\sqrt{(18-1)(18+1)}$$
$$= 36 + 2\sqrt{18^2 - 1};$$
$$(6\sqrt{2})^2 = 36 \times 2$$
$$= 36 + 36$$
$$= 36 + (2 \times 18).$$

$\therefore \sqrt{17} + \sqrt{19}$ is less than $6\sqrt{2}$.

7. NIL DESPERANDUM.—Find the value of
$$\frac{a + \sqrt{a^2 + b^2}}{a^3 - 2b(a^2 - b^2)}, \text{ when } a = -b \text{ and } b = -3.$$
(*Moffatt's* 'Pupil Teacher's Course.')

$$\frac{a + \sqrt{a^2 + b^2}}{a^3 - 2b(a^2 - b^2)} \quad \{a = 3 \text{ and } b = -3\}$$
$$= \frac{3 + \sqrt{3^2 + (-3)^2}}{3^3 - (2 \times -3)[3^2 - (-3)^2]}$$
$$= \frac{3 + \sqrt{9 + 9}}{27 + 6(9 - 9)}$$
$$= \frac{3 + \sqrt{18}}{27}$$
$$= \frac{3 + 3\sqrt{2}}{27}$$
$$= \frac{\sqrt{2} + 1}{9} \quad \text{Ans.}$$

Arithmetic.

1. ONTARIO. — The price of land about London is every year rising 4 per cent. on previous prices, while the purchasing power of gold as regards general commodities is falling $\frac{1}{2}$ per cent. per annum. A proprietor sells half his land this year for £8000, and invests the proceeds at 5 per cent. He proposes to sell the remainder three years hence, and to invest the money in the same way. What income would now represent the purchasing power of the income he will have obtained when the sales are completed? (*Men Clerkships, Lower Division.*)

Value of the land 1 year hence = £8000 + $\frac{1}{25}$ of £8000
= £8320;
,, ,, 2 years ,, = £8320 + $\frac{1}{25}$ of £8320
= £8320 + £332·8
= £8652·8;
,, ,, 3 ,, ,, = £8652·8 + $\frac{1}{25}$ of £8652·8
= £8652·8 + £346·112
= £8998·912;

Purchasing power of £100 one year hence = £100 × $\frac{999}{1000}$
= £99·5;
,, ,, ,, 2 years ,, = £99·5 × $\frac{999}{1000}$
= £99·0025;
,, ,, ,, 3 ,, ,, = £99·0025 × $\frac{999}{1000}$
= £98·5074875;

Total Income = 5 % on £8000 + £8998·912
= $\frac{1}{20}$ of £16998·912
= £849·9456;

∴ Purchasing power of total income

$$= £849{\cdot}9456 \times \frac{98{\cdot}5074875}{100}$$

$$= 98{\cdot}5074875 \times 849{\cdot}9456$$

5910449250
4925374375
3940299500
8865673875
8865673875
3940299500
7880599000
£837·2600556768000
20
s. 5·2011135360
12
d. 2·4133624320

= £837 5s. 2·4133624320d. Ans.

2. P.T.—The circumference of the earth in the Latitude of London is 15,120 miles; find the distance between two successive meridians of Longitude, and the space passed over by the Sun in his apparent daily motion in a minute. (*Colenso.*)

Distance between two successive meridians of Longitude
= $\frac{15120}{360}$ miles
= 42 miles. Ans.

Space passed over by the Sun in his apparent daily motion in a minute = $\frac{\overset{21}{\cancel{42}} \times \overset{15120}{\cancel{60}}}{\underset{2}{\cancel{24}} \times \cancel{60}}$ miles.

= 10½ miles. Ans.

3. FOLKESTONIAN. — In what proportions must wines of 15s., 20s., 26s., 30s. a gallon respectively, be mixed so as to give a profit of 14¼ per cent. on the cost, when sold for 24s. a gallon?

£ s. £
114¼ : 24 :: 100 : cost price of mixture
7 3
800

= 21s.

Difference between cost price of mixture and 1st kind = 21s. − 15s.
,, ,, ,, = 6s.;
,, ,, 2nd ,, = 21s. − 20s.
,, ,, ,, = 1s.;
,, ,, 3rd ,, = 26s. − 21s.
,, ,, ,, = 5s.;
,, ,, 4th ,, = 30s. − 21s.
,, ,, ,, = 9s.;

∴ Quantity of 1st and 2nd kinds : Quantity of 3rd and 4th kinds :: 5s. + 9s. : 6s. + 1s.
:: 14s. : 7s.
:: 2 : 1.

∴ Proportion = 2 gals. at 15s.
2 ,, ,, 20s.
1 gal. ,, 26s.
1 ,, ,, 30s.
} Ans.

Science Notes.

PROFESSOR KUNKEL, of Wursburg, has just found that though the interior of the body retains a quite constant temperature of 98—100 degrees Fahrenheit, the heat of the skin varies considerably in different parts. In the face, for instance, in adult men it ranges from 85 to 89 degrees. The skin of the more exposed parts of the body, the nose and ears, seldom exceeds 75 degrees, and often falls to 72. The highest surface temperature appears in men in the full vigour of life. The skin of children is cooler than that of adults, being from 77 to 84 degrees.

***

WE learn from *Nature* that in December, 1882, parties of astronomers were scattered over the world to observe the transit of Venus across the sun's disc, which took place on the 8th of that month. The observations then secured by parties sent out by the British Government have been reduced under the direction of Mr. Stone, director of the Radcliffe Observatory, Oxford, whose report has just been published. Expeditions were sent from England to Jamaica, Barbadoes, Bermuda, the Cape, Madagascar, New Zealand, and Brisbane, at all of which, except Brisbane, satisfactory results were obtained. In addition to this the colonies equipped stations in Canada, Victoria, New South Wales, South Australia, Queensland, New Zealand, Mauritius, Natal, and the Cape. The object of the observations was to determine as nearly as possible the sun's distance, which is, so to speak, the standard yard of the astronomer, and was referred to by the late Astronomer Royal as the noblest problem of astronomy. In 1874 and 1882 photography was used to aid the solution of the problem. Notwithstanding the fact that three transits had been observed, the observers of 1882 had to overcome an uncertainty of about one-and-a-half millions of miles. In discussing the observations of 1882 Mr. Stone aimed at securing two independent observations of the sun's distance, one from a comparison of the observations of entry on the sun's disc, and one from the observations of egress. From 24 observations of the first the distance of 92,654,000 miles (subject to an uncertainty of 240,000 miles) is obtained; from the second, 92,319,000 miles (subject to an uncertainty of 370,000 miles), or, combining the two classes of observations, we have the distance of the sun equal to 92,560,000 miles, with an uncertainty of 250,000 miles. This value is 190,000 miles less than that deduced from the British observations of the transit of 1874.

***

THE twenty-sixth volume of the meteorological observations made at the Government Observatory, *Bombay*, which contains the results for the year 1885, has been issued, under the superintendence of Mr. C. Chambers, F.R.S. Continuous records have been obtained by self-recording instruments, and eye observations are taken five times a day as a check upon the automatic records. The following is a summary of the principal meteorological results:—The mean barometric pressure for the year was 29·826 inches, the difference of the greatest and least mean daily pressure amounting to ·581 of an inch. The mean

annual temperature was 79·2, the greatest daily mean 87·3 on June 6th. The absolute maximum was 91·8, which was slightly *lower* than the maximum in the shade at Greenwich on the 4th of July, and the minimum was 62·1 in February. Thus the range of temperature was 29·7. In this country during the last twelve months it has been quite three times as much. The rainfall was 67·91 inches, rain falling on 113 days. The greatest fall was on the 15th of August, when it was 10·29 inches, or about ten times as much as we get in this country during what we call a steady rain.

***

SIR PHILIP MAGNUS has presented his report on the Technological Examination held in 1887 under the direction of the City and Guilds of London Institute for the advancement of Technical Education. A special feature of this year's work is that 48 candidates were examined in nine subjects under the direction of the Institute in New South Wales. Examinations were held in Sydney, Bathurst, and Newcastle. The questions were sent out to Sydney, and the answers were forwarded to London, where they were examined, together with those of other candidates, the date of examination being so timed as to render this possible. Sir Philip Magnus considers that the increase of the total number of candidates examined and of those who have passed is satisfactory. In 1886, 4,764 candidates were examined, of whom 2,627 passed: in 1887, 5,508 candidates were examined, of whom 3,090 passed. The increase in the number of candidates in 1887 is 744. During the past session 365 classes were held in 121 different towns. Manchester heads the list of provincial centres, from which the largest number of candidates have passed, the number being 183 as against 169 in the previous year. Next in order comes Glasgow, with 169 as against 163; then Leeds, with 114 as against 81; Blackburn with 73 as against 10; Huddersfield with 69 as against 70; Belfast with 66 as against 74.

***

IN a recent number of *Longman's Magazine* there is a most interesting article by Mr. F. Weber, organist of the German Chapel Royal, St. James's Palace. The object of the article is to show that not only are there numbers of pleasing sounds in Nature which may be noted by an attentive ear, but also that these sounds are most melodious and harmonious, and form exact intervals and chords. Mr. Weber goes on to write down in musical notation many of the sounds heard in conversation, such as—How is your friend to-day? Is he quite well? Yes, thank you, quite well; and how are you? Thank you, I am quite well. Dr. William Pole, in a letter written to *Nature*, criticises adversely the position taken up by Mr. Weber. He first states that for sounds to become music they must have a fixed and definite pitch, and further they must have certain relations to each other: form part of some series called musical scales. He then proceeds to show that though two fixed sounds uttered by animals—the cuckoo for instance—may accidentally agree with some recognised interval, yet they do not necessarily do so. Dr. Pole totally disbelieves that ordinary speech is music ready made. Street cries and calls are purposely sung, not said. In natural speech, he points out, there are no musical sounds so called, inasmuch as it is scarcely possible for a hearer to catch notes of fixed and definite pitch, the voice tends constantly to wander about in a vague and indefinite way; the vocal chords under the natural prompting have no tendency to remain at a permanent degree of tension; to keep them so there must be an intentional artificial effort, and hence the occurrence in speaking of a monotone long sustained is unusual, and has a distinct musical character. The moment this is done speech ceases to be natural and becomes a musical performance.

Publications Received.

Blackie and Son—

Sonntag's French Grammar. Part I.
Vere Foster's Copy Books. No. 14.
Poynter's Drawing for the Standards. Books 13 to 18.

Brown, A., and Co.—

A New Mode of Geometrical Demonstration. By David Maver.

Chapman and Hall—

Science and Art. No. 5.

Greenwell, T.—

Second Grade Freehand Test Cards. By A. Thomas.

Heywood, John—

The Scholar's Geography. By J. S. Horn.
A County Atlas of England and Wales.
The National Atlas.

Jarrold and Sons—

The Teaching of and Testing in Mental Arithmetic.

Johnstone, W. and A. K.—

The Pupil Teacher's Geographical Year Books. Second Year.

Miscellaneous—

Ridge's Patent Slate-Racks.

Murby, Thomas—

The Graphic Historical Reader. Book 4.

Smith, Elder and Co.—

The Cornhill Magazine. August.

Taylerson and Co.—

The Systematic School and Home Lesson Record.

The Clarendon Press—

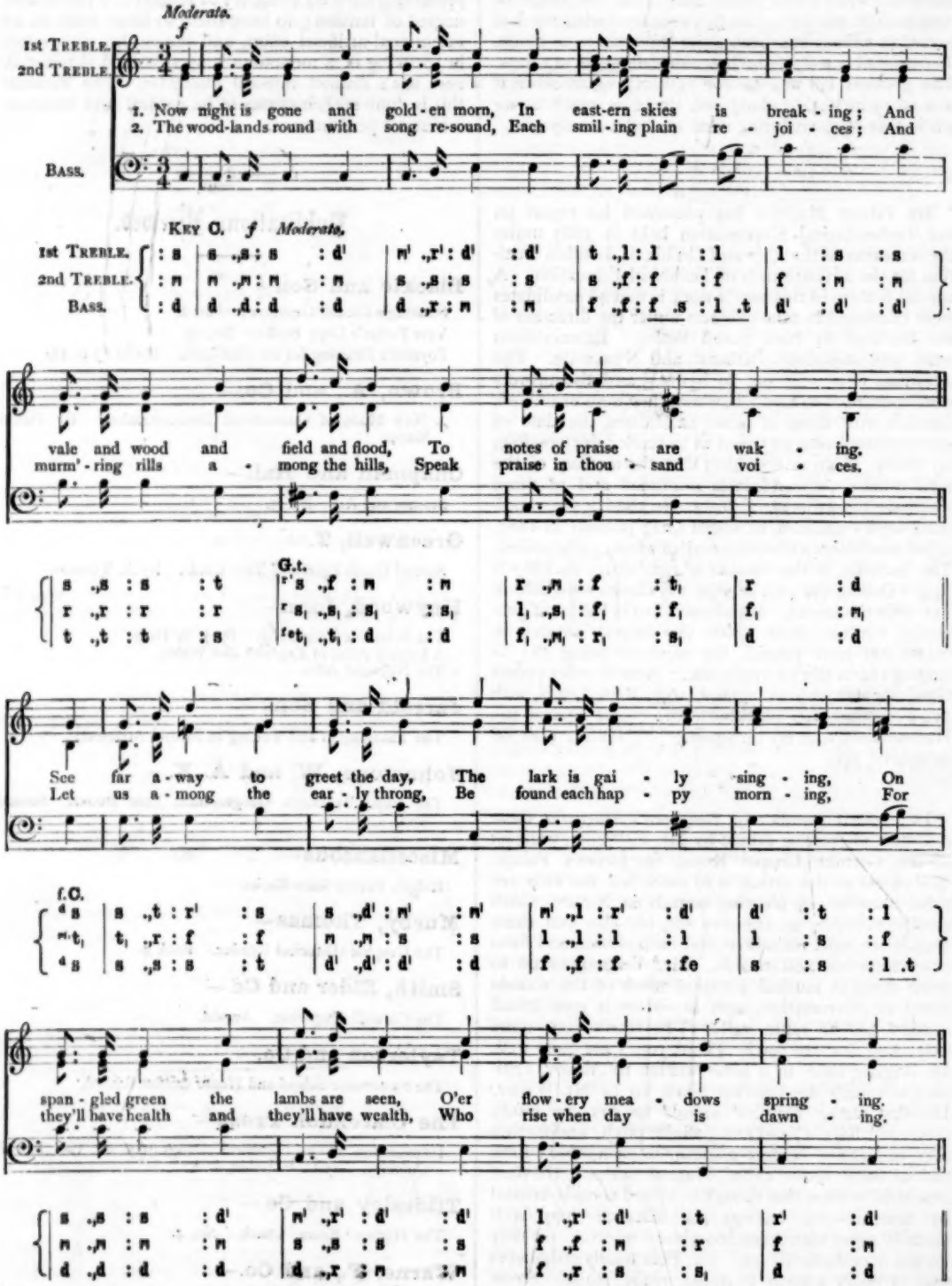
Introduction to a Historical Geography of the British Colonies. By C. P. Lucas, B.A.

Tildesley and Co.—

The Higher 'Exam.' Coach. No. 4.

Warne, F., and Co.—

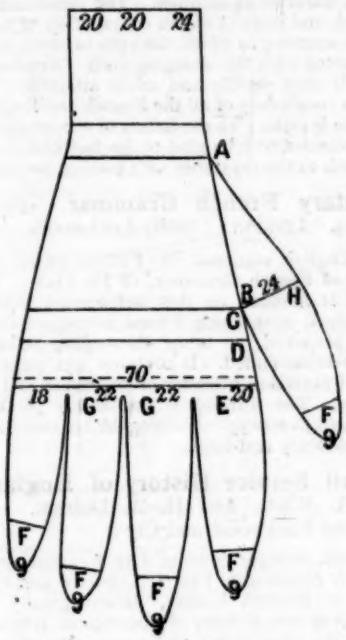
Carpenter's Popular Elocutionist and Reciter. By Leopold Wagner.

MORNING.

Moderato.
f
1st TREBLE.
2nd TREBLE.
BASS.
1. Now night is gone and gold-en morn, In east-ern skies is break-ing; And
2. The wood-lands round with song re-sound, Each smil-ing plain re-joi-ces; And
KEY C. f Moderato.
vale and wood and field and flood, To notes of praise are wak-ing.
murm'-ring rills a-mong the hills, Speak praise in thou-sand voi-ces.
G.t.
See far a-way to greet the day, The lark is gai-ly sing-ing, On
Let us a-mong the ear-ly throng, Be found each hap-py morn-ing, For
f.C.
span-gled green the lambs are seen, O'er flow-ery mea-dows spring-ing.
they'll have health and they'll have wealth, Who rise when day is dawn-ing.

Knitting Maps.

BY MRS. J. D. HARRIS.

GENTLEMAN'S GLOVE.



Pins No. 14.

2½ oz. of Scotch or Berlin Fingering.

The pattern in this glove is—knit 1, purl 1 for one round. Knit 2 plain rounds.

N.B.—You must be careful to keep the knitted stitches even in each succeeding pattern. The increasings for the thumb gusset are *always* in the knit, and purl round.

Cast on 24, 20, 20—64 in all.

Knit 2, purl 2, for 2 inches.

Knit 3 rounds of the pattern.

To form the Thumb Gusset.

A. Knit 1, purl 1, take up, and knit a stitch.

Knit 1, purl 1, take up 1. *Mark* the next stitch as you knit it, and finish the round and the two plain rounds.

In each succeeding knit and purl round, take up a stitch *after* the first purled stitch and *before* the marked knitted stitch, keeping the pattern even between.

B. Increase till you have 20 stitches on the gusset. Thread these off with a rug needle, on rather thick wool, as it makes it easier to pick them up afterwards.

C. Knit three rounds of pattern.

D. Pick up every fourth stitch till you have 70 stitches in all on four pins.

(To pick up these stitches you should take the stitch of the last row, not the loop between, as this prevents making a hole.)

Knit 2 more rounds of pattern.

First Finger.

E. On the pin where the thumb gusset is taken off, knit 10. Thread all the remaining stitches on wool, except the last 10. Place 4 of the already knitted stitches on another pin, and knit 2 from the last pin on it. Knit the finger in the pattern the length required.

(To measure for the length of the fingers, slip the glove on the hand, and as soon as they are knitted to the root of the nail begin the reducings.)

To reduce for tip of Finger.

F. Knit 2, knit 2 together, for 1 round.

Knit 2 plain rounds between each reducing. When only 9 stitches left, thread them with a rug needle, draw them up inside, and fasten off securely.

Second Finger.

G. Take up the 9 stitches that are opposite each other on 2 pins. Fasten in the wool by knitting a stitch, and then knitting 5 more stitches with the double thread. On a second pin knit the three stitches that are left, and 5 from the other pin. On the third pin knit the 4, and pick up 4 more between the fingers. Knit the required length, and reduce as at F.

Third Finger.

The same as G.

Fourth Finger.

To the stitches that are left add, between the fingers, enough to make 18 in all.

The Thumb.

H. Put 8 stitches on the first pin, 6 on the second, and 6 on the third. Add 4 more in the opening. Knit and finish off exactly like the fingers.

Both gloves may be knitted alike, but if preferred, the left hand glove may be made by forming the thumb gusset at the end of the first needle.

The first reducing should be when you are 4 stitches from the end, and that stitch should be marked.

A Mitten is knitted exactly the same to the end of the thumb gusset. Then rib an inch and half, or 2 inches, cast off, and rib an inch for the thumb, and cast off.

Publications Reviewed.

The Early Tudors: Henry VII., Henry VIII. By the Rev. C. E. Moberley, M.A. London: Longmans, Green and Co.

Mr. Moberley's volume on the first two Tudor sovereigns forms a welcome and worthy addition to Messrs. Longmans' well-known series—'Epochs of Modern History.' In a book like this, with so limited a period, it is possible to give the history in much greater detail than in ordinary school manuals; and when the work is undertaken by such competent hands the result is a very valuable introduction to larger histories. The substance of the best authorities is presented in reasonable space, and while advantage is taken of Froude's researches, his conclusions are corrected and modified by the work of other and more recent writers. The style is clear, plain, and straightforward, with a careful avoidance of florid writing. In the portions dealing with literary and social progress, especially in the chapters on maritime discovery and the revival of classical learning, the composition is lighted up and pervaded by a genuine but subdued glow of enthusiasm. The intertwining of English history with that of the continent receives much attention and is very clearly set forth.

The Handbook of Preliminary Arithmetic. London: Longmans, Green and Co.

This is the fifth of the series of 'Open Competition Handbooks,' edited by Dr. Chetwode Crawley for the publishers. It contains forty-two sets of arithmetic questions given in open preliminary and qualifying competitions for various posts in the Civil Service during the years 1878—1887. The questions are printed in bold type, and the book in stiff boards is of post quarto size. The papers are preceded by the usual arithmetical tables, in one of which we notice a singular omission. In long measure no connection whatever is shown between the pole and the furlong, leaving the student in perplexity as to the relationship of the two, and the value of the latter. Answers, in every case correct, so far as we have been able to test them, are appended. Intending candidates will do well to secure the book, as it will afford ample practice for the arithmetic examinations named.

The Cutter-Out. Parts I. and II. By Mrs. Maclear. London: Longmans, Green and Co.

This is an attempt, and in our opinion a successful attempt, to provide diagrams and tables for cutting out every size of the various under-garments comprised in the sheets. Each packet contains six sheets of diagrams and tables, and one sheet of instructions and rules. Although the sheets seem complicated we have had no difficulty in following the instructions given, and all the information required for cutting out the paper patterns for a garment of under-clothing of any size is given on each sheet. Certainty of success and economy of material and time will be ensured by the use of these sheets.

Vere Foster's Copy Books. Bold Writing Series. No. 14. London: Blackie and Son.

Like the other numbers of this series already noticed, this number provides a good model for a firm open, bold, civil-service style of writing. The headlines are historical, and the ruling is for double small hand.

The Government Tests in Arithmetic. Standards II.—VII. By D. HAYES. London and Liverpool: George Philip and Son.

We have examined carefully these six packets of Test Cards, and find them a well-prepared practical set. Each packet contains 40 cards of four sums, three of which are usually straightforward sums, the fourth a problem, within the capacity of the average well-taught standard child. The cards are strong, differently coloured for the various standards, very clearly and beautifully printed, and accompanying each packet are two copies of answers. The forward child will find in them plenty of variety, the backward child will not be disheartened by inability to master some at least of the sums on each card. They have our cordial approval.

Combination Test Cards. Standards II.—VII. London: Cassell and Co.

These cards contain questions in arithmetic on one side, and questions in grammar and geography on the other. In all the questions are suitable to the various standards, and are of a character to test the intelligence and capabilities of the children. None of the problems are far-fetched, but all are eminently practical, while the sets travel over the whole of the ground covered by the code. The cards for Standards II.—IV. contain four questions on each side, and are very clearly and boldly printed. Those for Standards V.—VII. have six questions on each side. While giving more variety this has a tendency seriously to lessen the size of type, and although they are printed with all Messrs. Cassell's usual care, yet the smallness of the type must be a serious hindrance to their use in the dull hours of the winter months. Answer cards accompany each packet, and, with the exception named, the whole set can be very highly commended.

Blackie's Elementary Text Books: Sonntag's French Grammar, Part I. London: Blackie and Son.

This little work is compiled principally for the English and Scotch Codes. The lessons are carefully graduated, each containing some memory work and instruction in the language, an exercise on the lesson, and a dictation or reading exercise in addition. The verbs are gradually introduced, and instead of the conjugation of verbs only, the whole sentence in which the verb is used is supposed to be repeated with the changing verb. Readiness of expression is thus rapidly and easily attained. The book contains a vocabulary of all the French and English words used in the lessons. In the hands of a competent teacher English children will be glad to be introduced by means of this book to the mysteries of a foreign language.

Elementary French Grammar. By Dr. De Fivas. London: Crosby Lockwood.

Most English students of French know the 'New Grammar of French Grammar,' of De Fivas. This work before us is founded on that well-known work, and to those engaged in teaching French to beginners no more carefully prepared, or more thoroughly reliable book could be recommended. It contains 132 pages of accidence and exercises, a reader of 36 pages, and a copious vocabulary. The printing is thoroughly good, and the binding is extra strong. Nothing better could be desired as an elementary text-book.

The Civil Service History of England. By F. A. White and H. A. Dobson. London: Crosby Lockwood and Co.

This work, brought down to date, has reached its sixth edition. It contains in Part I. a concise and clear compendium of English history, chronologically arranged. Part II. comprises a series of appendices relating to the growth of the constitution of England, the chief treaties, the battlefields, the colonies, the biography, and the literature of British India. It would be difficult to find a work more accurate in detail, or containing so much reliable and varied information in so small a compass. A very full index gives great facility of reference to the volume.

Longmans' Handbooks of English: Home Lesson Books to Longmans' New Readers. Books 1 to 6. London: Longmans, Green and Co.

The matter contained in these little manuals is extracted from the excellent series of reading books we have previously noticed. The lessons include alphabetical vocabularies of all the difficult words in the reading lessons, pages of script, clearly printed in white on black for Standard I., dictation exercises for Standard II., a well-arranged course of notes and exercises on grammar and word-building for the other standards, and a good selection of poetry for recitation, with short and simple explanations in each book. Arithmetical tables are inserted in the first four standards. The books are well-printed and firmly stitched in linen covers. The use of such handbooks is likely to save much wear and tear of the series of readers, and may on this and other grounds be strongly recommended.

Longmans' New Geographical Readers. Standard I. and Standard VII. London: Longmans and Co.

The issue of these two volumes worthily completes the series of seven readers admirably adapted for the intelligent teaching of geography according to the standards of the Education Code. The First Reader contains lessons on the making and meaning of plans and maps, on the cardinal points, and also on various typical regions of the globe, with accounts of the men, animals and plants to be

found in them. The language is simple, and the style in which the lessons are written makes them as pleasant and interesting as the chapters of a child's story. Suitable verses are interspersed with the other lessons; spelling lists are given; and summaries are boldly printed in script.

The Seventh Book deals with the ocean, currents, tides, the planetary system, and the phases of the moon. The lessons are made valuable by passages selected from the best authorities, such as Tyndall, Darwin, Humboldt, Hartwig, Lady Brassey, and others; and the interest is secured by the vivid descriptions of famous voyages of discovery, like those of Captain Cook, Henry Hudson, Sir John Franklin, McClintock and other great explorers. Poems by Coleridge, Lord Byron, Barry Cornwall, Mrs. Hemans, serve to illustrate the subject. Explanatory notes are appended to each lesson; and a summary of the whole with an excellent folding map showing the currents completes the book.

Both volumes are beautifully printed, and abundantly illustrated with good engravings.

The Holiday Concert: A School Cantata. By J. O. Murdoch. London: Curwen and Son.

The aim of this work is to provide a series of connected Character or Action Songs, the whole forming, as the name implies, a Holiday Concert. The general plan is commendable, but we are sorry to say that the music is not quite up to the level of the 'School Music' issued by this firm. While free from glaring errors (if we except certain unresolved dominant sevenths, as on page 2, and at several other places throughout the work) the music is decidedly commonplace, much of it in fact consisting of trite and well known phrases, strung together as though the composer were jotting down old tunes imperfectly remembered, producing the effect upon the hearer of an entire lack of originality. For example, the section commencing with the fourth score of page 2, is simply a paraphrase of portions of a popular song—'The Midshipmite.'

It is of course possible that these seeming plagiarisms are intentional references to the melodies they suggest, but as there is no evidence of such intention the critic is bound to analyze the music as he finds it.

On the other hand, there are many good points in connection with the Cantata which would recommend it for school use. The music is easy, the range well suited to the voices, and the two-part choruses effectively written.

Local Examination History. By Dr. R. S. Pringle. Manchester: John Heywood.

This book, noticed in a former number of the *Practical Teacher*, has reached a seventh edition and seems to have supplied a want. A few facts have been added to bring the information down to the present date. All compilations of this kind however should be used only as memory aids and not as the sole means of providing a knowledge of the history of our country.

My First Trigonometry. By M. H. Senior. London: Swan Sonnenschein and Co.

This is a little work of 120 pages, which the author hopes may serve to introduce the interesting and educationally valuable subject of Trigonometry into a vast number of schools where it has not yet found a place. Mr. Senior writes with knowledge on the subject as to what the majority of boys take in and what they do not.

The unit of circular measure, which is, according to Mr. Senior's statement, a great difficulty with many, is very carefully explained, and a new syllable is added to the term 'radian,' which has lately come into use to express this unit, as he believes that 'radiangle' conveys a more distinct idea than the shorter form; perhaps it does.

Very nearly one-tenth of the book is taken up with the question of the measurement of angles by the three well-known methods.

Carefully as the different ratios of an angle are explained, the author assumes a knowledge of a ratio, which is just what so many students have not. They cannot grasp the fact that a ratio is an abstract number integral or fractional, and so dissociate it from lines, &c.

In the fourth chapter—though the convention of the signs of lines, according to the direction in which they are drawn, is stated, no sort of explanation or illustration is offered which may serve to give the student the rationale of such an idea.

The work only advances as far as the solution of triangles, omitting the second case, and does not touch on inverse notation, or the relationship between the sides of a triangle and the radii of circles described in and about them.

The examples are not numerous, and we were very sorry to find in the middle of the last set an unexplained rule for finding the distance of the horizon at sea, with which to work out one or two examples.

We cannot help thinking the book is capable of great improvement in many ways, and especially in introducing more geometrical proofs of well-known formulæ.

Students like to see proofs, or at any rate an intelligible realization of a formula, and to obtain this by simply an analytical treatment of certain expressions is almost impossible; *e.g.*, if a student will draw a triangle and drop the perpendicular from the vertex on the base he can realise thoroughly that its area is ½ base × the altitude; but very few can equally realise that the area is and must be equal to the expression $\sqrt{s\,(s-a)\,(s-b)\,(s-c)}$ when a, b, c are the sides and $s = \frac{1}{2}\,(a + b + c)$. There are, however, many most important formulæ that can be easily proved geometrically, and such we think ought to be introduced in any elementary trigonometry.

Blackie's School Classics: The Lady of the Lake. Canto V. By Sir Walter Scott.

The Elegy and other Poems. By Thomas Gray. London: Blackie and Son.

In these two little books we have first a brief and well-written biographical notice of the poets, and prefixed to the selection from the 'Lady of the Lake,' we find an introductory note which recounts in a couple of pages of pages of small type the chief incidents of the whole story. The text is clearly printed, and at the foot of each page are explanatory notes suitable and sufficient for the elucidation of every difficulty, and the illustration of every allusion. Interesting etymologies are given, and parallel passages from other authors. The other poems which follow Gray's famous Elegy are, the Ode on a Distant Prospect of Eton College, and the Bard. The study of these finished poems, with the help afforded by these little text books, will form a useful and interesting course of literary training for young people.

Arithmetic for University Examinations: Scotland. Edinburgh and London: W. and R. Chambers.

This is a book of questions only, its special value lying in the fact that these questions are selected from the local and other examinations conducted by the Scottish Universities. Nearly 800 questions are arranged in exercises under headings indicating the rules which they exemplify; and some hundreds more are given as miscellaneous and additional questions, with specimen papers printed as set at Edinburgh, Glasgow, Aberdeen, and St. Andrews. To most of the questions references are added to show where and when they were set in examinations. Such a collection of exercises cannot fail to be useful to candidates preparing for examinations in Scotland and similar ones in England. The answers are published separately.

Progressive French Course. Part I. By M. Duport. London: The Educational Supply Association.

This little book is very neatly got up, the type large and clear, and the lessons just of sufficient length to fully exemplify the rules without being tedious. There are 25 very useful vocabularies at the beginning of the book, each arranged according to a different subject—birds, food, fishes, &c.

Another useful feature, especially for young boys, is the conjugation of verbs negatively, and negatively and interrogatively. Would it not be better to print the English of each tense in full? In two very important respects, however, the author of this work has taken a backward step.

Instead of giving a vocabulary to each separate exercise, as is now almost universally done, the author has merely given a general vocabulary at the end, the use of which involves the loss of much valuable time, and very heavily handicaps those who may use this book.

Since the stem of the verb is the invariable part and requires little exertion in learning, why call attention, say to the stem of the preterite definite *parl-*, by printing it in large black type instead of directing the eye of the student by the use of black type to the six different endings. If the author will in a future edition make the changes we have pointed out we feel confident this work would be extensively used for junior classes in many schools.

'Notes of Lessons,' 'Hints to Pupil Teachers,' 'Recent Inspection Questions,' as well as a large number of Reviews, are, owing to pressure on our space, unavoidably held over, and will appear in our next issue.

The 'Practical Teacher' Sale and Exchange Column.

Owing to numerous requests, we have been induced to start this Exchange Column for the benefit of our readers. We shall be glad to insert announcements relating to the 'Sale or Exchange' of books, etc., at the rate of ONE PENNY PER LINE, *prepaid.*

For Sale.—Volumes I. to VI. of PRACTICAL TEACHER, unbound; in excellent condition.—Offers to J. W., 31, Curtis-terrace, Fratton, Portsmouth.

For Sale.—Colenso's 'Arithmetic' (pub. at 4s. 6d.), sale price 2s. 6d.; Angel's 'Geometry' (1s.), 8d.; Murby's 'Prayer Book,' 6d.; Rawle's 'Geometry' (1s.), 7d.; Cornwell's 'School Geography' (3s. 6d.), 2s. 6d.; Chamber's 'English Language and Literature,' 5d.; Philips' 'Geography of British Isles' (1s. 6d.), 10d.; 'Notes of Lessons,' by Rickard and Taylor (2s. 6d.), 1s. 6d. Good condition.—Address A. Hunter, 8, Sheraton-street, Darlington.

What Offers?—'Outlines of English History,' Evan Daniel; Murby's 'Geography and Atlas,' A. H. Dick, D.Sc.; PRACTICAL TEACHER, Volume V., and Nos. 9, 10, 11, 12 of Vol. IV.; 'Puritan Revolution,' S. R. Gardiner; 'The World we Live In,' D. T. Anstead, M.A., 2s.; 'Physical Geography,' S. B. J. Skertchly, F.G.S.; Nugent's 'Eng.-Fre. and Fre.-Eng. Dictionary;' Abbot's 'Via Latina;' Macturk's 'Physical Geography'; Hall's 'First French Course;' C. H. Gill's 'Chemistry for Schools,' 4s.; Miller's 'Inorganic Chemistry,' 3s. 6d.—Address J. Allison, 80, Stanley-grove, Longsight, Manchester.

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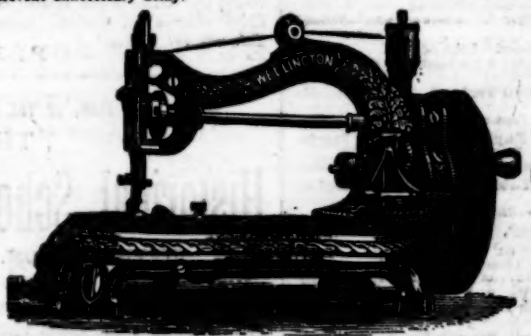

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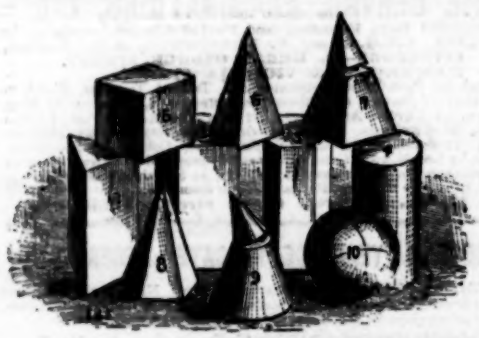

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